AMATEUR WORK

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ALBO-METAL RELEIF.

Under the name of "Albo-Metal Relief," we have a new kind of *repousse'* work that will commend itself to amateurs on account of its simplicity, cleanliness, and the freedom from noise connected with its execution. In enumerating these advantages, we have said notl-ing of the good effect that is one of its chief merits. In its natural condition it resembles handsomely embossed silver or highly polished pewter. It is guaranteed not to tarnish and is very durable.

Beautiful results are to be obtained by tinting certain parts of the design by the aid of Cinque-cento laquers. These are easily applied and are to be had in blue, red, green, orange, yellow, maroon, purple, olive and brown.

Fig. 1.—The Double-Ended Tracer.

Fig. 2.—The Double-Ended Ball Modeller

Fig. 3.—The Steel Leveller.

Fig. 4. — The Matting Punch.

The tools required are of a simple nature, and are not unlike those employed for leather work and other arts. A tracer is needed for making out the design upon the metal. This is pointed at one end and rounded at the other end, Fig. 1, and is made of boxwood which, while firm enough to do its work well does not pierce the metal. The ball modeller, Fig. 2, also made of wood, is employed for rounding the design, and it often calls for the co-operation of the tracer. Fig. 3 shows the steel leveller for smoothing out the background previously to punching it with a matting punch in Fig. 3 to produce a pitted effect. A firm wooden table should be procured for working upon, or an ordinary drawing board. There is no messiness connected with this work with average care, so no special corner of the family sitting-room need be set apart for it, as is the case with wood-carving, fretwork, and some other arts. Upon the table or drawing-board should be stretched some thick cloth or felt. In all probability the household ironing blanket will be available and can be well borrowed. We are supposing that the design has already been chosen, and that it

Fig. 5.—Photograph-Frame with Albo-Metal Decoration.

has been drawn distinctly upon a sheet of moderately thick paper. The sheet of metal should be spread, face upwards, upon one fold of the blanket; over it must be laid the design, the two materials being held together with stamp paper round the edges. Take the double-ended tracer, Fig. 1, and follow all the outlines with it. It is not necessary to do more at this stage than to mark out the design, so that it is plainly visible upon the metal. Remove the cloth and work over

the outline again; this is the final tracing, so any little mperfections there may be can now be improved, and the outline in general made more distinct. Any veins of leaves, markings of flowers and other touches that there may be inside the outline must be put in.

Turn the metal over—that is, wrong side upward—and place it again upon the blanket, this time using two or three layers. Take the ball modeller, Fig. 2, or the tracer, Fig. 1, as may happen to be most convenient for the detail upon which the work is to be done, and press the design out from the back. Do this pressing evenly and, as it were, gradually, so that the metal becomes stretched and rounded, not pushed out with anything like an angular result. Take away the flannel and again turn the metal right side uppermost. Rub down the ground thoroughly with the leveller, Fig. 3. Press this carefully into all the angles between the design and round all the curves. This will throw the pattern up into still higher relief.

The next thing to do is to punch the ground all over to produce the pitted effect already mentioned. The metal should be laid on a slab of slate, marble, stone, or some similar hard and smooth material, and the punch should be held fully upright over the work and tapped with a light hammer.

The *repousse'* has next to be filled up at the back to prevent it from becoming dented in course of use. There are several substances that may be employed for this purpose, but the Relievo filling that is sold for gesso modelling is particularly clean and pleasant to use. It simply needs to be rubbed down with water till it is of the consistency of cream.

The composition must only be placed in the hollows of the *repousse'* work. None of it can be allowed to spread over the ground of the design, but if this should happen it can be easily taken off with a brush while wet, or with a penknife when dry. It is possible also that the filling may sink while drying, and if this is the case it must be raised by the adding of some more of the paste put on with a brush till it is exactly the level of the background. Leave the work till dry, then paste a sheet of paper over the whole of the background, using photographic mountenant or some other adhesive of a similar kind. When this is dry the decoration can be affixed with Tenasitine to any wooden, leather, or other kind of article for which it is destined. In this way, also, it is possible to utilize even the smallest scraps of the metal. They may have effective devices embossed upon them, and those may be cut round the edges and glued down to the corners of blotters, boxes and the like. The metal is thin and soft enough to be easily cut with scissors or a sharp penknife. In all probability it would lend itself well to fretwork, but of this method of employing it we have as yet had no personal experience. Certain it is that many of our wood-carving designs would work out well in this relief metal work.

Before parting with our subject altogether it is advisable to remind inexperienced workers that, when the paper has been pasted over the metal this must be laid, face downwards, on a soft pad of blanket or flannel, a board placed on the top, and upon this a heavy weight of books. This is to ensure that the paper will keep smoothly in its place, and the work should be left thus under pressure until it is dry. The same set of tools and the Relievo filling may be employed also for copper modelling. Thin copper costs rather less than the Albo-metal, but it does not keep its color nearly so well, and does not, in consequenee, offer so much attraction to an amateur.—"Hobbies, London."

EGG SKINS FOR WOUNDS.

At a recent session of the Therapeutical Association of Paris, Dr. Amat lectured on the use of the membrane of eggs in the treatment of wounds. He has observed for some time the good results of placing these membranes upon the surface of wounds, and reports two new cases, that of a young girl suffering from a burn on her foot, and a man, 40 year old, with a large ulcer on his leg. Both wounds were in process of healing and were covered with healthy granulations. The surgeon overspread them with six or eight pieces of the membrane of eggs which was covered with tin foil and fastened with dry antiseptic bandages. After four days the membrane of the egg had partly grown into the tissues and had caused the growing of a good skin. That the egg membrane had contributed much to the healing process was demonstrated in the further course of treatment. It seems, however, that the membrane does not always adhere. The process of cicatrization is not only hastened but the wound heals exceptionally well and leaves but few perceptible traces. As these membranes are procurable everywhere, their use should attract more attention.

An English paper reports that a Norwegian has invented a telephone by which the noise made by fish in the depths of the sea can be heard. The instrument consists of a microphone in a hermatically sealed steel box. It is connected with a telephone on shipboard by electric wires, each sound in the water being intensified by the microphone. The inventor asserts that with its aid the presence of fish, and approximately their number and kind, can be recognized. When herrings or smaller fish are encountered in large numbers they make a whistling noise, and the sound made by codfish is more like howling. If they come near the submarine telephone their motion can be distinguished. The flow of water through the gills produces a noise similar to the labored breathing of a quadruped, and the motion of the fins produce a dull rolling sound.

THE LIGHTNING ROD.

It is interesting to observe the grogress of the lightning rod in the favor of men competent to judge of its merits. Years ago it was the bane of the land, and the lightning-rod agent was as little favored as the hobo of today. Very likely there was a good reason for this, for he certainly was the Baron Munchausen of applied electricity, yet it is apparent that some of the things that he did without other reason than to sell plenty of his twisted rods are now looked upon with favor by those who have studied the protection of structures from lightning. The disfavor of the lightning rod is certainly diminishing, and recently the National Fire Protection Association in this country and the Lightning Research Committee in Great Britain have been paying much attention to the subject.

Fortunately, it is now possible to understand why destruction formerly occurred in structures well equipped with rods properly installed. These cases, which were largely the cause of the lack of confidence shown in such protection, we now know to be due to an unusual form of lightning, and on account of the general growth of interest in the subject, it is timely mention the new theory of these discharges. Some years ago it was pointed out by Sir Oliver Lodge and others, that lightning was of two classes, which that physicist named the A and B flashes, respectively. The A flash, as explained in the recent report of the Lightning Research Committee, is of the simple type that arises when an electrically-charged cloud approaches the surface of the earth without an intermediate cloud intervening. Under these conditions the ordinary type of lightning conductor acts in two ways ; first, by silent discharge, and second, by absorbing the energy of a disruptive discharge. In the second class, B, where another cloud intervenes between the cloud carrying the primary charge and the earth, the two clouds practically form a condenser. When a discharge from the first takes place into the second, the free charge on the earth side of the lower cloud is suddenly relieved, and the disruptive discharge from the latter to the earth takes such an erratic course that no series of lightning conductors of the hitherto recognized type suffice to protect the building.

The reason for this latter statement can be best explained by pointing out the change in the opinions held concerning the character of lightning discharges. Formerly, as Dr. Lodge recently pointed out, electricity was treated as if it had no inertia and all that was necessary was to get it from the clouds to earth as quickly and easily as possible by the shortest path. It is now recognized, however, that it is not so much the quantity of electricity that has to be attended to as the electrical energy. The problem is to dissipate as quietly as possible this electrical energy stored between the clouds and the earth in dangerous amounts. A sudden dissipation of energy is always violent, and nobody in his senses tries to stop a heavy flywheel or a railway train suddenly. It is exactly the same with the store of energy beneath an electrified cloud or between one cloud and another. A perfect conductor, if struck, would deal with the energy in such a rapid manner that the result would be equivalent to an explosion. Hence the conductors must be of moderately high resistance. In any case, however, the rush is likely to be rather violent, and, like an avalanche, it will not take the easiest path provided for it. No one path artificially provided can be said to protect others, and the only safe protection is the impracticable one of encasing the building wholly in metal.

This statement explains why the points of conductors are sometimes inoperative in protecting a structure. When the energy is stored between cloud and cloud, instead of between cloud and earth, and the initial discharge is from one cloud to another, the lower cloud is liable to overflow suddenly to the earth through a region where there has been no previous preparation, and where any number of points or a rainshower or any other means for a gentle leak would be quite inoperative. A violent discharge can then occur at the sharpest point, and in this connection it should be observed that a column of heated air like that rising in a chimney is even preferred by the lightning to an ordinary conductor. These considerations have led the British committee to make the following practical suggestions concerning protection against lightning: Two main lightning rods, one on each side, should be provided, extending from the top of each tower, spire or high chimney by the most direct course to earth. Horizontal conductors should connect all the vertical rods (a) along the ridge or any other suitable position on the roof, and (b) at or near the ground line. The upper horizontal conductor should be fitted with aigrettes or points at intervals of 26 or 30 feet. Short vertical rods should be erected along minor pinnacles and connected with the upper horizontal conductors. All roof metals, such as finals, ridging, rainwater and ventilating pipes, metal cowls, lead flashing, gutters and the like, should be connected to the horizontal conductors. All large masses of metal in the building should be connected to earth either directly or indirectly by means of the lower horizontal conductor. Where roofs are partially or wholly metal-lined, they should be connected to earth by means of vertical rods at several points. Gas pipes should be kept as far away as possible from the positions occupied by lightning conductors, and as an addittonal protection the service mains to the gas meter should have a metallic connection with house service leading from the meter.

These suggestions are much less minute in their de-

tails than those recently made by the committee of the National Fire Proteciion Association, but it is not unlikely that they are about as useful in actual practice. They omit one suggestion that is strongly urged in this country by several investigators of lightning phenomena, and that is the provision of points and conductors on large trees in the vicinity of buildings. This provision, which seems to have originated in a suggestion made by Prof. Elihu Thompson, is a very good one for some cases. The most important feature of the work being done on both sides of the Atlantic is, however, the careful investsgation of cases of damage by lightning and the examination by men of high standing among electrical engineers of the data thus acquired. This work will eventually result in lifting the ban imposed by the public on the lightning rod, and will add somewhat to the safety of buildings and high chimneys against a class of accidents which are commonly classed as unpreventable.—"The Engineering Record."

THE INTERRUPTION OF PRIMARY CURRENTS IN RUHMKORFF COILS.

OSCAR N. DAME.

In connection with the operation of induction or spark coils, we find the interrupter he easiest part to manufacture, but the most difficult to design to meet the condition of the coil with which it is to be used. With small coils, using a battery of from four to ten dry cells, an apparently trifling change in the length of a vibrator, the weight of the head, the position of the platinum contacts or the back tension or throw causes a wide variance in spark results, and quite often from lack of understanding the cause of some trouble, a coil is condemned because the designer or manufacturer used a "stock" vibrator, instead of building one adjustacle to the primary and secondary conditions.

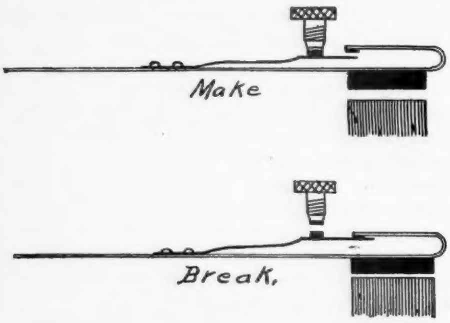


Fig. 1.

As in the designing of motor and dynamo armatures, special attention is given to permeability, etc.; so is it with primary cores, and the best material for a primary core is the finest grade of annealed iron wire, bundled into proper cylindrical form and dipped in shellac. No. 24 or 26 Swedish iron gives superior results.

The purpose of the primary winding is to furnish the proper number of conducting turns to energize the core and make a powerful magnet of it, and usually the best results are obtained with not over four layers. In planning the number of layers one must consider the space occupied by the secondary windings, for sufficient lines of force must be generated to reach the maximum number of turns in the secondary, so that the full value of the spark may result, yet on the other hand, the more turns on the primary the greater the resistance, the inductance, and in general the more sluggish the coil action. We find that the more turns we have on the primary, the greater the spark at the platinum points of the vibrating interrupter, and to care for this spark which, of course, is a result of intense primary saturation, we of necessity must place a larger condenser capacity in micro-farads across these points.

The higher the resistance of the primary, the less amperage available from the battery supply, and also the less likelihood of quick exhaustion of these batteries.

For a standard one-inch spark coil, operated by four dry cells, the vibrator is usually two inches in length, where the primary windings are not over three layers, which gives sufficient time for the "make" to allow the current to make a strong electro-magnet of the core. While electricity in itself is treated generally as instantaneous in its performances, in spark coil operation we find time an important factor. For example, a vibrator only two inches in length if connected to a six-inch coil, would not give satisfactory results because, owing to the very high speed of vibration of such a short piece of spring metal there is not sufficient time on the "make" and before the "break" to permit the primary to become properly saturated, and with the "break" of the circuit there is not sufficient time for demagnetization before the make occurs again. On the other hand, if we were to use a four inch vibrator on a one-inch spark coil, the result would be a splitting, lifeless spark, making the inch spark at times, but valueless for practical uses.

In all sizes of induction coils, the spark value is determined by the instantaneous break at the proper

time, often styled the long make and the quick break. All good vibrators are devised to make sudden break of contact at the proper moment, and this is usually accomplished by attachments connected to the vibrating part itself, which "kick" off the spark just as the vibrator is moving at its highest rate of speed. Figure 1 illustrates the principle of this "kick," different manufacturers applying different methods to accomplish the same result.

It will be noted that the lip is bent over from the head and does not strike the piece bearing the platinum contact until the vibrator is well down to the core, and by proper adjustment this kick will happen when the speed is the greatest.

On coils larger than three inches, core actuated interrupters are seldom used, because separately actuated magnetic interrupters give better saturation and a more instantaneous break. Figure 2 shows a vibrator frequently seen on moderately sized battery coils, and the spark results are far better than could be obtained with a vibrator actuated by the coil core. Cores on large coils possess sufficient instantaneous magnetism to act on the hammer head of a core-actuated vibrator as soon as the current enters the primary. Consequently the length of beat, which is commonly governed by the length of the vibrating metal, is not her ea factor. With a separate vibrator coil, wound with a few turns of suitable wire, the electro magnetic value of this coil does not reach a maximum as promptly as

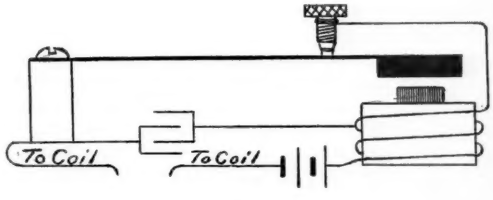


FIG 2.

in the coil primary, so the hammer head is not attracted until the coil itself is in readiness for the break. And because of the low resistance winding of this vibrator coil, and the few number of turns, neither resistance can affect the amperage of the primary to any extent, nor retard the reversals at the interruption and re-contact.

BOOK-BINDING FOR AMATEURS.

WINTHROP C. PEABODY.

VII. Putting on the Covers.

A previously mentioned, preference is given in these articles to the styles of biuding likely to be most used by those who care only to bind magazines and books with inexpensive but durable bindings. In accordance with this idea, the covers to be first described will be those known as "cloth."

This brings us to one of the difficulties likely to be experienced by the amateur who buys his materials in small quantities, thus depriving him of the opportunity of buying of the wholesale houses who sell only the quantity comprised in original packages. An exception is sometimes made in cloth, leather and twines, but the mill-board packages are not broken. The latter must be obtained elsewhere, and the small jobbing bindery will be found the best place to make purchases, as at such places the remainder of lots used for other work can usually be had at a small advance in price over that charged by the wholesaler.

Mill-board is obtainable in two regular sizes, 22 x 26 in. and 20 x 30 in. It is designated by numbers which refer to the number of sheets in 100 lbs. of board, as 12, 16, 18, 20, 25, 30, etc., up to 100 sheets per 100 lbs. weight, the latter being but little thicker than a heavy paper. The mill board used in the bound volumes of AMATEUR WORK are known as "30," which means that 30 sheets would weigh 100 lbs.

Binders' cloth comes in rolls and is 38 in. wide. This can be purchased by the yard, the price varying from 12 to 20 cents per yard for the cheaper grades, and from 20 to 40 cents for the better. A yard of cloth will cover several books, so this item of expense is not a heavy one.

To prepare the "covers," as cloth bindings are termed before being put on, the mill-board is cut to the required size. The margins to allow can be determined by an examination of other books of about the same size. It will be noted that the back edge does not meet the "backing" of the book, the space left being sufficient to form the hinge, so that the cover may be opened wide, yet not enough to cause looseness with continued use.

In cutting the cloth, an easy way for the beginner to get correct size and spacing is to draw a diagram which is dimensioned by measurements of the book to be covered. Note the space to be left between the two boards, and the amount to be turned over on the inside, also allowing for the thickness of the boards. The way to trim and turn in at the corners can readily be learned from books already at hand.

With boards and cloth cut and in readiness, the next process is gluing together. Regular binders have glue-pots contained in a hot water can, which serves

te keep the glue fluid while using. If the reader lacks this and is binding but few books at one time, a bottle of liquid glue will serve, but it will be necessary to thin it until it will drop freely from the brush, much as would paint.

The cloth is then spread flat upon a smooth board or upon a sheet of clean wrapping paper, coated with a thin, even layer of glue, which should be applied as quickly as possible, brushing out any spots where too much glue has been applied. The boards are then placed in their proper places, the edges of the cloth turned over, after cutting out at the corners, smoothing over with an ivory folder. Care must be used, however, when using cloth with a grained pattern, not to press too hard, or the pattern will be rubbed out, leaving smooth spots which will greatly mar the appearance of the work. All that is necessary is that the cloth shall be firmly in contact with the boards at all places, so that when the glue is dry no "blisters" will appear.

On the inside of the cover between the boards a strip of strong paper, manila of moderate thickness will answer, is placed. It should be a trifle short of reaching the outer edges of the boards. The lap of the cloth is then turned over upon itself, the edges just meeting the ends of the paper. If the covers are not attached to the book at once they should dry between boards, the press boards serving for this purpose, which will prevent them from curling out of shape.

To put on the covers, coat the loose parts of the backing cloth with glue, place the book back downward in the proper place in the open covers, firmly press the cloth with the ivory, open the end papers, which have previously been covered with a strong paste, press the end papers smooth, using care not to stretch them, close the book and run the edge of the ivory along the back edge of each cover between the board and rounded backing, and the book is complete.

Nothing has been said about lettering or tool work of any kind; this will be taken up in a subsequent chapter.

A beautiful dead-black ebony stain, largely used by camera-makers for blacking the insides of camera woodwork, carriers, etc., is made by first coating the wood with a strong decoction of ground logwood, or wood chips, in hot water and then, when nearly dry, applying a solution made by putting 6 or 8 oz. of iron filings into the bottle, shaking occasionally for a few days before use. This will impart a fine and even black to mahogany, or any sort of wood—a black that will neither chip, powder nor rub off, and with a perfect non reflective surface. For external parts of apparatus, a more finished appearance will be imparted by rubbing over with boiled linseed oil.

DESTROYING PLANT LICE.

The Practical Counsellor for Fruit and Garden Culture, of Frankfort, Germany, recently offered a prize for the best method of destroying plant lice, for which 58 persons competed. The prize was awarded to the author of the following preparation: Quassia wood 2½ pounds, to be soaked overnight in 10 quarts of water and well boiled, then strained through a cloth, and placed, with 100 quarts of water in a petroleum barrel with 5 pounds of soft soap. The mixture is then ready for sprinkling on plants infested with lice. Leaves, even those of peach trees, will not be injured in the least by the solution, which can be kept covered in the barrel from spring to fall without deterioration. As soon as the lice appear the leaves should be sprinkled with the solution. If this is repeated several times, the pests will disappear.

A DEATH TEST.

Although physicians assert that the possibility of being buried alive can only occur where a medical examination has not been made, German papers state that a stronger, absolutely reliable guaranty for discerning actual death is still demanded. The discovery of a new modium for ascertaining death with perfect certainty will, therefore, attract attention. It consists in injecting a solution of fluorescine deep into the tissues. If circulation exists the skin and mucous membranes become very yellow and the eyes assume the color of emeralds; if the circulation has ceased, none of these results occur. The discoverer, Dr. Icard, proposes that at least two hours before bodies are placed in coffins such an injection with fluorescine be made. If life is not yet extinct the injection does no harm and the coloring disappears.

On the principal railways of France the traveller finds his train keeping to the left set of rails. This is what he is used to in England; but when he emerges from the station and takes a tram car or cab he finds his vehicle and all others inclining to the right. When he comes into Germany he finds trains rigidly keeping to the right like road vehicles. Why is the difference, asks an English traveller. In France the railroad was not developed from the colliery tramway as this had been from the plank road, but was imported from England, and with it the left hand direction. Once settled the railways have stayed so—with a flavor of the exoctic about them still.

German locomotive engineers receive a gold medal and $500 for every 10 years of service without accident.

A CHEAP NINE-INCH REFLECTOR.

M. A. AINSLEY.

II. Medium and Fine Grinding.

MEDIUM GRINDING.

We will suppose now that the mirror is roughened out, and that the depth of the concavity in the center is judged sufficient. It is hard to say how long this should take. My own mirror took well over ten hours to rough out, but with carborundum and a smaller mirror the work would be far quicker. However, my first mirror was of rather short focus—only 7 diameters—and I certainly should not recommend less than 8½ or 9 diameters for focal length.

The first thing is to get rid of every trace of the rough emery. The tool, mirror, handle, bench, etc., must be thoroughly rinsed and filled up with fresh water. The utmost attention to this is absolutely necessary every time the grade of emery is changed; otherwise the final surface is sure to show scratches which, if not appreciably affecting the performance of the mirror, are unsightly and unworkmanlike.

Having everything clean and free from grit, we "carry on" with No. 46, or No. 80, or something of the sort. It is not necessary to use so much at a "wet," and at this point we may shorten the stroke and introduce side motion. In fact, I have obtained the best results as regards freedom from sticking and regularity of curve by keeping the stroke quite irregular, sometimes circular, then straight for a bit, then elliptical, then spinning the mirror on its center for a second or two, and then perhaps returning to a short, quick, straight stroke with a little (1 in. or so) side motion. This is a matter on which there may be several opinions; but I can only say that in working my second 9 in. mirror I never had the semblance of a "stick" from beginning to end of the fine-grinding, and the spherical surface produced left nothing to be desired, both as tested optically and by the spherometer. The grinding is continued with No. 40 until the surface made by the coarse "roughing-out" emery is replaced by a uniform surface due to the 46, all coarse pittings having disappeared. This will not take long; but it is absolutely necessary to get rid of every trace of the rough surface. I have found it a good plan to have a series of plate-glass discs ground with the different emeries used, one ground with "1½," one with "46," one with "180," and one with "washed flour." The surface of the mirror can be compared with these as the work proceeds, and with the help of a pocket lens it is easy to see if the surface is a true "46" or "180" surface, and so on, or if any trace of the previous surface remains.

When the "46" surface is perfect all over, we may wet the mirror and test its focal length, either, preferably, by direct measurement in the sunshine, or by observing the reflection of a candle flame. If the mirror is made thoroughly wet and kept so, as Mr. Ellison recommends, and the image of the sun received on a visiting card, the position of the card where the image is smallest will give an approximate focus, and the focal length can be measured by means of a tape or a piece of string. If not short enough we must continue the rough-grinding a bit further; if too short, the position of tool and mirror should be reversed for a bit; but if care is taken, this should not be necessary, and it may be repeated that the focal length does not matter so long as it is less than seven or eight times the diameter of the mirror. I will leave the mirror at this stage for the present. My next will deal with the fine grinding.

FINE GRINDING.

We have now got rid of the surface produced by the coarse emery, and the figure of the speculum is beginning to approximate to a sphere. The object of the fine-grinding is to perfect the spherical figure as far as possible, and to render the surface so fine that it can be readily polished. The fine-grinding is commenced with No. 120, 150 or 180—it does not much matter which—and continued in the same manner as before until all trace of the "49" surface is gone. It will be found a great convenience to apply the emery to the tool by means of a flat, soft brush. The brush is dipped in water, then into the emery, and the small quantity it takes up is painted evenly over the tool. There is little fear of sticking at this stage; but if it occurs it is a sign that the emery is not spread over the tool sufficiently even. The stroke is kept irregular, as already indicated. It should not take long to get rid of the 46 surface, and, as I said in my last, it is important to do so completely. Any impatience at this stage of the work will render the final surface difficult to polish. After the 130, washed flour emery is used in the same way and with a similar stroke.

The use of the brush to apply the emery is even more to be recommended with the washed flour. If care is taken to have the emery quite evenly distributed, so that actual contact of the glass surfaces does not take place, sticking can be completely avoided. A little saliva, or a small quantity of soap in the water, will help to this end.

The "washed flour" produces a very fine surface, but not nearly sufficiently fine to polish; so it is necessary for the worker to prepare his finer emeries himself. My way was as follows:

Take 2 lbs. or so of washed flour emery and stir it

up in a jug with half a gallon of water, then leave it to stand for one minute. The coarse emery will sink to the bottom, leaving the finer sorts in suspension; after the minute has elapsed, the water, holding in suspension the emery required, is poured or siphoned off into a basin, where it is allowed to settle for several hours. The water is then poured off and the emery may be dried and collected. The process is repeated, except that five minutes are allowed to elapse before pouring; then 15 or 20 minutes, then 40 minutes. It is possible to go even further, but I found that little was gained. We thus abtain a series of washed emeries of increasing fineness, the quantity obtained, of course, decreasing as the length of time during which the emery is allowed to remain in suspension increases. Very little of the finer grades is, however, required, and 4 lbs of washed flour should prove ample for a 9 in. Of course the "one minute" and "five minute" not required can be returned to the washing jug. Care must, of course, be taken that none of the sediment in the washing jug comes over with the liquid. A siphon of india-rubber tubing is distinctly useful.

In practice it is not necessary to dry these emeries, the superfluous water having been drained off; they can be applied to the tool with a soft, flat, camel's-hair brush, and will contain just about the right amount of water required.

It will be seen that I used 1, 5, 20 and 40-minute emeries. There is no virtue in these figures, all that is required being to secure a steady diminution in the size of the grains.

After each grade is finished with, it is a good plan to add water to the emery left on the tool, and grind for a few minutes with the small quantity of emery left. This tends to fineness of surface.

Here a word of warning may not be out of place. The motion of mirror over tool with the fine emeries is exquisitely smooth and frictionless, and the mirror should never be left to itself on the tool without a hand to hold it, otherwise it is very liable to slip off with disastrous consequences.

Some workers recommend that the tool should be divided into squares, by grooves either ground or filed out. This is said to prevent sticking, and in large work is, I believe, essential. But I did not find it necessary for my 9 in., and in any case it would be a tedious job to cut the grooves. The fine-grinding is is not the least fascinating part of the work, the surface produced being so exquisitely fine it has been compared to the side of a tumbler in which milk has just been, and should be semi-transparent, so that a candle flame can be seen at a distance of 10 ft. or more. In my case, after the fine-grinding was complete, large type could be read through the speculum placed on its back, although the glass is 1¼ in. thick.

The importance of obtaining a really fine surface before polishing cannot be over-estimated. It is impossible to get a really good polish unless the surface is properly prepared, and each grade should be used until it fails to produce any further effect. Moreover, if care is taken over the fine-grinding, the surface produced will be almost perfectly spherical.

On the completion of the fine-grinding the wooden disc and handles should be removed. This is easily done by standing the mirror on its edge, holding it firmly, and striking the edge of the wooden disc with a mallet. Any pitch left on the back of the mirror can be scraped off and finally washed off with turpentine.—"English Mechanic."

PAPAYA JUICE.

Papaya juice is extracted from the fruit of the papaw tree, which grows rapidly, attaining its full bearing capacity in a year. It produces from 40 to 50 papaws of a dark green color, ripening to a deep yellow, resembling in shape a squash. A very light superficial incision is made in the fruit, from which exudes a clear water-like juice which, on exposure to the air, becomes opaque. As it drips from the fruit it is received in a porcelain-lined receptacle. As it is very corrosive, metal receptacles would injure its appearance and qualities. It possesses great digestive virtues, and the refined article is considered superior to all animal pepsins.

After the desired quantity has been collected the juice is placed in shallow porcelain or glass lined pans and allowed to evaporate. While this is not a very delicate or difficult operation, it requires considerable attention so that the juice will dry uniformly and the product be white and well granulated. In its granulated state it is shipped to the united States, undergoes a refining process, and is sold as the papaw of commerce for medicinal purposes.

The ripe papaw is palatable, and an excellent aid to digestion. Meat wrapped in papaw leaves for a short time becomes quite tender without any impairment in appearance or taste.

In extracting the juice the hands should be protected by rubber gloves, as in its crude state it attacks the tissues. An average tree will produce about one-fourth of the granulated juice. It sells in the United States for from $4 to $6 per pound in the crude state.

German papers report that a new anæshetic juice has recently been discovered in Japan, the product of a plant growing in that Empire. This anæsthetic has been called scopolamine, and is said to be superior in its effects to all other articles of this kind. It is administered hyperdermically and produces a deep sleep lasting from eight to nine hours. If the assertion concerning scopolamine are confirmed, it will certainly be used in surgical operations, as it is claimed that it does not produce the slightest ill after-effects, which are always to be feared with the anæsthetics hitherto used.

PHOTOGRAPHY.

THE CARBON PROCESS.

CHESTER F. STILES.

The name "carbon process" is a misnomer, as in this most beautiful of photo devices, we are not held down to a rigid set of tones, but may, by varying our coloring materials, produce any tone at will. "Pigment process" would more accurately describe it.

In the carbon process our work is more of a mechanical nature than chemical. and therefore our control over printing is almost unlimited. We simply dissolve away by warm water the parts of the picture not affected by light, and by varying the temperature of the developing bath in this operation, we can retard or accelerate at will. We are not, however, as was formerly the case, obliged to prepare these tissues ourselves, for several varieties, and all necessary colors are available at photo supply stores. This tissue, however, must be sensitized at home, as it does not keep well after sensitizing.

Before going into specific details we must briefly sketch the process in a general way. The "tissue," which is the technical name for a piece of carbon paper, consists of a film of gelatine, into which pigments of the desired colors are incorporated. These pigments are minutely ground and are selected with the same care as artists' fine colors. The tissues are sensitized by the operator in a weak solution of bichromate of potash in warm water, after which they are dried for use. They are now sensitive to light and must be handled with more care than the ordinary printing-out papers.

Unlike the papers of the last-mentioned type, the carbon tissue does not show a visible image. The action of light is simply to render the gelatine insoluble wherever the light strikes—the eye can see no difference. In order to time the printing we have recourse to an "actinometer," which we will later describe in detail. When the actinometer shows that the printing is complete, we remove the tissue in a semi-dark room, and develop the image by means of hot water.

A little thought here will show that the surface of the gelatine must be all insoluble because some light has been received by all portions of it. We are therefore obliged to work in from the back, and to do so must transfer the tissue temporarily to a support for development. This, of course, reverses rights and lefts, so when the development is complete another transfer may be necessary. In such an event we may, however, apply the tissue to a variety of supports—glass, paper, porcelain, wood, etc., making it the most versatile of all printing processes.

We would recommend that the novice in carbon content himself with the single transfer process. By selecting a negative which will bear right for left reversing ,such as a landscape, we may use the temporary support as a permanent one. We require the three dishes, one for cold water, one for hot water and another for a saturated solution of alum. Use dishes large enough to afford plenty of room and do not use rubber or composition trays for the hot water, for very obvious reasons.

The other materials necessary are some black varnish and a brush, a quantity of powdered alum, a few pieces of opal glass a little larger than the tissue used, a squeegee, and a board to operate on. For the varnish and brush may be substituted a ten-cent package of lantern binders to be used for making the "safe edge" on the negative, of which more further on. Opal glass is porcelain glass like the white opaque lamp shades. It is obtainable of glaziers and photo supply stores.

The sensitizing solution for carbon tissue is made by dissolving one ounce of bichromate of potash in 20 of water. This is an average formula, for in winter it is wise to make it somewhat stronger, and in summer, weaker. The bichromate is an orange salt which dissolves rapidly in water. Use hot water and filter while hot, so as to filter rapidly. Alcohol is added by some to the sensitizing bath to produce a quick drying tissue.

Use a deep zinc or porcelain tray and sensitize by immersion. Keep the pigment side up and watch for air bubbles on the surface. Authorities vary as to the length of time necessary in the sensitizer, but one to two minutes will usually be sufficient. Of great importance, however, is the temperature. Have this uniformly at a temperature between 50° and 65°.

After sensitizing, hang in a warm room where the tissue will dry quickly. The room should not be less than 70°, for tissue dried too slowly becomes insoluble in developing.

By means of the varnish we paint a border of black completely around the negative on the film side, or accomplish this same object by pasting on the lantern binders. After this the printing frame is made ready as usual, the operations being performed in very subdued daylight or by full lamplight. The pigment side is placed in contact with the negative, and another negative of as nearly the same density as possible is made ready with ordinary Solio paper in a separate printing frame.

The two negatives are placed in the sun together. When the silver paper begins to show detail in the dense parts, the carbon prints should be about finished. The tissue is then placed in the dish of cold water, care being taken to break all air bubbles which other-

wise make spots. When the weather is dry the tissues will be dry and stiff; when damp they are much more limp. In case the tissue is dry, the cold water will end to roll it up. We must take care to keep the tissue under the water till it begins to flatten. The damper tissues do not need as much care and soaking.

The opal for the support being handy, we place the tissue upon it quickly, and squeeze out all superfluous moisture and air. When this is done, the opal, with print upon it, is placed between blotters under pressure. In about five minutes it is ready for development.

The water for development should be at about 10° Fahr. The pigment commences to ooze out after a few seconds from between the opal glass and the paper of the tissue. When the proper time arrives the paper will strip easily from the tissue itself, but do not hurry this operation, for the tissue is delicate and will not stand forcing. In all this manipulation it is essential to keep the opal plate completely immersed in the developing water, so as to prevent tearing.

When the paper comes off, wash the print gently with the warm water. The pigment not acted on by light will gradually loosen and fall away from the tissue, and the image will begin to appear. Now, if the printing is correctly done, the development will be at a normal speed and well under control; but if an over-exposure was made, somewhat hotter water will be required to dissolve away the gelatine pigment. Conversely, if an under-exposure is indicated by a wholesale falling away of detail, we must quickly arrest development by cold water, and modify the developing temperature to suit. Extreme latitude is thus secured. Skillful carbon printers lose few sheets of tissue by errors.

When development is complete we stop it by immersion in cold water. It should be rinsed till the drippings are quite clear. After this, a bath of alum serves to move the bicarbonate and to harden the gelatine film.

It is here necessary to explain the "safe edge." We wish to prevent the light from acting clear to the edge of the tissue, for in this case the paper back would cling to the tissue and tear away pieces of the image. By putting on the safe edge we preserve a soluble border of gelatine around the printed image, and the paper back detaches easily.

The "actinometer" makes a better printing guide than the plan above suggested. It may be constructed in a few minutes spare time. Get a small printing frame about 4x5, with a glass to fit. Cut a strip of tracing cloth, or onion skin paper, about 4 inches long, and an inch wide. Next cut a similar strip of 4¾, 4½, 4¼ in., etc., of the same width as the first. Lay the set over one another on the glass so that the longest is on the bottom, and we will then have a series of steps and cover the rest of the clear glass on the plate with black paper. Number with opaque ink the various steps from one upwards.

The actinometer is used in place of the trial negative mentioned before. One negative may need printing till the actinometer shows light action under the number 8, for instance; another may need but 5, and so on. Once the correct number is found it is marked on the negative. It should be possible to make perfect and uniform prints from a negative from here on, as the actinometer is an accurate measure of light.

As stated before, the single transfer process is only applicable to a few subjects. A portrait is allowable in single transfer, and landscapes in an artistic sense. There is, however, a curious difference between the two sides of a face in an ordinary person, and while always recognizable, a single transfer print sometimes gives queer expressions to familiar faces. Similarly a landscape reversed from right to left will sometimes be unrecognized by people who know the locality well. A picture including a sign of any kind would, of course, be ridiculous, as the printing of the sign would run backward.

The description of the carbon process, like many another of the photo operations, is much more complicated than the operation itself. Thus, in the soaking of the tissue before the first transfer, a little judgment must be used. Too long an immersion in water spoils the sticking property of the tissue. When the tissue is hard and brittle it curls inward in the water and must be soaked till it starts to flatten out and become limp. But as soon as the flattening commences it indicates the time for squeegeeing to the temporary support. If the tissue be left in the water till it curls outward, the chances are much against its adhering at all.

The double transfer process is quite easy after a little experience with the simple single process. We need now, in addition to our outfit, some temporary supports. These may be of ground opal, or the more convenient "flexible temporary support" may be obtained at the dealers. Note that the temporary support must be waxed thoroughly else the print would stick to it permanently and could not be transferred.

The waxing solution is made as below:

No. 1. Benzol, 1 oz., brown wax, 3 gr.

No. 2. Spirits turpentine, 1 oz., resin, 12 gr.

Dissolve separately and mix. Pour a little on a cloth and rub over the temporary support, polishing with a second cloth.

The flexible temporary support is covered with insoluble gelatine and shellac. The waxing prevents the tissue from sticking fast at the last transfer.

The exposed print is carried through the preliminary processes just as for single transfer. We are now ready to make the last transfer, and while the developing operations are going on, a piece of commercial "double transfer paper" should be soaking in warm water. When the transfer paper becomes shiny we may then proceed to the final transfer.

The developed print on the temporary support is fixed from bichromate by the bath of alum. It is then

thoroughly rinsed and put away to dry. The transfer should be made as soon as the drying is complete. We bring the shiny transfer paper of the preceding paragraph into immediate contact by squeegeeing. This serves to remove air bubbles and superfluous moisture.

We next dry the tissue, double transfer paper and attached temporary support in a warm current of air, after which the temporary support may be removed. The tissue will adhere to the final support if all the operations are correctly performed, and the image now shows in the correct position.

Failure to leave the temporary support shows incomplete waxing; failure to stick to the permanent support shows this support to have been incompletely sealed. If ground opal has been used for a temporary support the print takes on a matt surface, but remains smooth if the commercial support is used.

We come now to a most curious property of the carbon process which is used by experienced carbon printers with great success. We refer to the continuing action of light, which is the property of exposed carbon tissues to gain detail without further action of light when not developed immediately after printing. If we have a batch of carbons which do not develop fully, we may set them aside a day or so, and the remainder of the lot will develop perfectly well. A carbon printer of long experience uses this property to save time in printing when rushed. He prints several actinometer tints short of the correct time, then lets the tissue rest and gain density over night.

The keeping quality of sensitive tissue is fair. It is wiser to make for immediate needs, however. Tissue kept too long becomes insoluble and won't develop. The same defect is caused by dampness. The correction of these defects is quite obvious.

Another cause of insolubility comes from acid bichromate of potash or from impurities in the chemical. Slow drying also produces bad effects. The drying, however, in sensitizing or in the ordinary processes should never be greatly forced. A natural drying is preferable in every branch of photo work.

Before squeegeeing the tissue to temporary supports we should blot off the excess of moisture, otherwise spots may develop on the finished prints. Drying between blotters is recommended to remove the moisture.

Tissue which has just been sensitized does not work well; after two or three days the results are more even and satisfactory. The newly sensitized tissue is lacking in details in the high lights, which defect may also come from underprinting or too hot developing bath.

An operation called "sunning" is recommended by many professionals. This a few seconds exposure of the blank sensitized tissue to sun before placing in the printing frame. It has the effect of tinting over the high lights and making the surface of the tissue entirely insoluble. It, therefore, adheres perfectly to the supports. Sunning is almost a necessity for prints with extreme contrasts.

To retouch or spot out defects, use some of the first drippings in the development. Obviously the color matching will be perfect.

Carbons may be transferred to other supports than paper. If wood, canvas, stone, etc., are used, it is first necessary to prepare the surface with gelatine made insoluble. This may be done by means of chrome-alum, or some of the gelatine may be treated with bichromate and a vigorous sunning given to the prepared surface.

IODINE CURE FOR TUBERCULOSIS.

United States Consul Harlan W. Brush, of Milan, Italy, transmits information regarding the reported discovery, by Prof. Joseph Levi, of Milan, of a cure of tuberculosis by the use of a specially prepared iodine. Prof. Levi, who for many years has been connected with the Veterinary School of Milan, has practiced the use of iodine on horses for the last twenty years, and now announces that by his new method consumption can not only be arrested, but be completely cured. He says:

It is a well known fact that iodine can immediately convert itself into vaccine and become a virus of the most active and deadly kind. It follows from this that a person affected with tuberculosis becomes capable of making by himself and in himself, his own curative serum, ready for healing purposes when this iodine can circulate intelligently in the blood. And it is precisely this which I have obtained by my new method.

Prof. d'Auria, of Naples, made many encouraging experiments with iodine in cases of tuberculosis, as also Durante before him, but from what is alleged, Prof. Levi has now brought former theories and experiments to a definite solution.

A short time ago several new locomotives of German manufacture but of what is here styled the American "Atlantic" type, were put in service on the fast express line between Cologne, Berlin, and Aix la Chapelle. The boilers are considerably larger than in the usual German engines, in consequence of which the smokestack is very low, being of the same height as the dome. The diameter of the driving wheels has been considerably increased and they are driven by four cylinders. There are two distinct furnaces fitted with smoke consuming apparatus, which seems to produce good results. These locomotives have attracted much attention by their massive and powerful appearance, and have proved to be more powerful and speedy than the ordinary German engines, so there is every prospect of their number being increased. The tender is likewise built after the American pattern and is so constructed as to carry an extra large supply of water in addition to fuel.

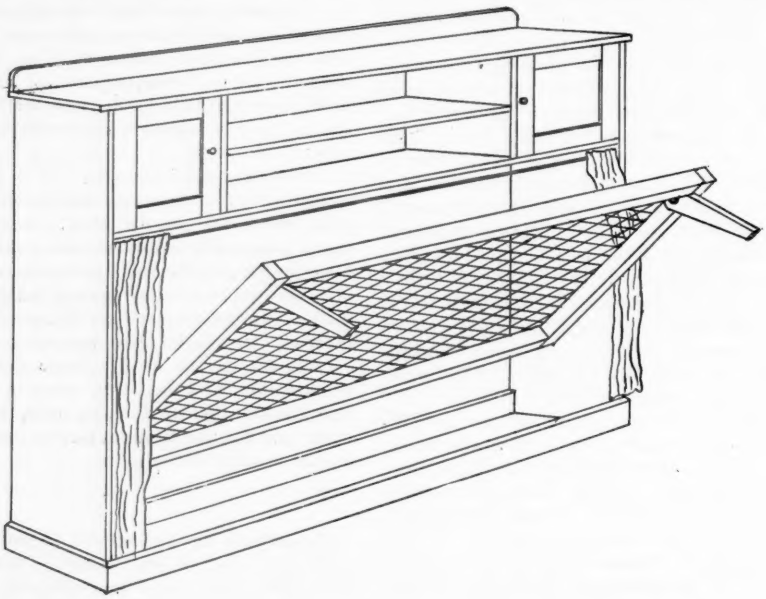
A STUDENT'S FOLDING BED.

JOHN F. ADAMS.

The usual student's room is one in which surplus space is not abundant, and where the furniture has been selected to fit the available places. When visitors are numerous, as they frequently are, the host is then cramped for room in his efforts to accommodate, and the writer has more than once had bed, bureau, tables, etc., utilized as seats, with a small drafting-board on the waste basket for himself. At such times a folding bed, similar to the one here described would have made it possible to have seated three more (with borrowed chairs) at these by-gone deliberations.

springs. This should be done in either case, as different makes vary slightly in size.

The end boards should be about 10 in. wide, the top board 11 in. wide, and the back board at the top 3 in. in. wide; the latter may be omitted if desired. The strips around the bottom are 3½ in. wide with upper edge planed to a slight bevel. The strip across the back is sunk in, by cutting out the corners of the end boards, so that the rear side will be flush with the rear edge of the ends, thus allowing the bed to stand firm against the base board of the room.



This bed consists of an ordinary wire spring with wooden frame, to be found on sale at all furniture dealers. It is attached to the casing with a ½-in. bolt at each end, as will be hereafter described. When not in use it is lifted to a vertical position, the curtains are drawn, and it then resembles a bookcase with curtained front. The illustration shows a top with two cupboards at the ends, and shelves; but a more simple design would have just the top shelf and backboard, as shown. In the latter case the springs can well be full size, 4 ft. 6 in. wide; with the cupboards and shelves the single width, 3 ft. 6 in. would be best.

The latter, only, will be described, as the other can be easily made without dimensions by first making a sketch and adding dimensions after purchasing the

The shelves and top board are fastened to ends with 2 in. screws, the heads being deeply countersunk to allow for puttying.

Between the ends of the spring frame and the end boards are fastened blocks of wood about 1½ in. thick, to provide room at the ends for the curtains. The holes in the spring frame for the bolts are bored large enough to receive, with a loose fit, a bushing of brass or drawn steel tubing, the length of which is a trifle greater than the thickness of the frame. With washers under the head of the bolts and also between the frame and the block above mentioned, the nuts can be screwed up tight without binding on the frame which turns on the bushing instead of on the bolts.

The legs at the front of the springs are attached with

$\frac{1}{2}$ in. lag screws, and placed so that when in position the outer edges will rest firmly against the frame, with the lower ends about 3 in. further out, thus avoiding any tendency to close up under the weight of the occupant, or when getting in or out of the bed. The upper ends are rounded on the inner corners to allow of folding back when not in use. Wooden buttons are mounted on blocks and fastened to the inner sides of the ends near the lower shelf to hold the springs when folded back. Stop blocks are also placed at the back.

Pieces of webbing with the free ends oversewed are tacked to the springs about one foot from each end, those at the back having buckles, which are used to hold the mattress and bed clothing in place when folded back. This allows the bed to be made up at any time, and it is then ready for use when taken down by simply removing the bands.

The backs of the cupboards are filled in with boards nailed through the ends and shelves. The curtain can be hung on large picture wire, or a small curtain rod, and the curtain should be of rather light material to slide into small space at the ends. Small angle irons are fastened to the back inner edges of the ends, projecting at the back the right distance to fasten to the walls of the room.

A headboard consisting of two strips $1\frac{1}{2} \times \frac{3}{4}$ in. and a cross piece $5 \times \frac{1}{2}$ in., can be attached by $\frac{1}{4}$ in. lag screws to the spring frame. There should be an open space under the cross piece of about 6 in. to permit the headboard to be folded. The headboard rests against the end when open, or stop blocks can be put at the lower ends of the strips. The headboard should have a slight outward incline. The wood for the frame should be any light wood; oak is too heavy.

INSTANTANEOUS X-RAY PHOTOS.

X-ray photography has labored under the disadvantage of demanding long exposure, while, for practical purposes, instantaneous pictures were required. Professer Rieder and Dr. Joseph Rosenthal, of Munich, have attained the desired end, reports Richard Guenther, U. S. Consul at Frankfort, Germany. After laborious experiments they have succeeded in obtaining in less than a second, X-ray photographs of the human chest, the patient ceasing to breathe meanwhile. Strong electric currents, especially good X-ray tubes, very sensitive photographic films and intensifying screens were used.

They have worked on unremittingly after their first success, and have now published in the "Medical Week" of Munich. a report concerning their further experiments. They find that high-priced and easily perishable films can be dispensed with, as less sensitive photographic plates will produce as good a picture in not more than a few seconds. It is, however, of the greatest importance that the time of exposure be shortened as much as possible for certain X-ray photographs, for instance, when it is desired to show the structure of the lungs.

While they formerly had taken a photograph during one intermission of breathing, they tried to reduce the time of exposure to the time between the beatings of the heart, as the heart beats impair the exactness of the picture. It was evident that for X-ray pictures of the heart such an accomplishment would be of great value. The first difficulty was to get a precise and reliable measurement of the length or time necessary to apply the rays for photographic purposes. This they accomplshed by a contrivance consisting principally of a wooden disk covered with lead, the diameter of which is about 39 inches. From this disk a sector was cut, amounting to about one-seventh of its total surface. The object to be photographed and the sensitive plate were placed behind the disk and the X-ray apparatus in front. The X-rays were passed through the opening in the disk while it revolved on its center once in a second, the exposure of the plate to the ray thus lasting one-seventh of a second. By changing the speed of the revolution of the disk the time of utilizing the X-rays could of course be either increased or decreased. The X-ray apparatus was supplied with a tube of very thin glass. In addition, the most sensitive films and especially strong X-rays were used. Good X-ray photographs were secured in one-tenth of a second. The outlines of the heart and of large portions of the lungs can be photographed with much greater success than was possible heretofore.

NEW WHITE PAINT.

British trade journals describe a new white paint, patented in Germany, which is claimed to far excel lead and other similar products, in fineness and smoothness of surface, covering power, permanence and cheapness. It is said to be obtained by saturating burnt lime containing magnesia with a hydrocarbon, and firing until all the carbon is burned. The material is then ground fine and colored ready for treatment with linseed or other saponifiable oils; with mineral oil, also, partial saponification takes place, resulting in a good workable paint. A dolomitic limestone, containing from 20 to 50 per cent of magnesia, is said to be best for the purpose, although a limestone having less than 20 per cent may be enriched by adding the desired quantity of magnesia, but with not such good results as are produced by the dolomite. Other pigments can be mixed with the material to produce paints of any required shades. The advantages claimed for the paint are that it dries quickly without driers, is unaffected by light, and not changed by ammonia, sulphurated hydrogen, or sulphurous acid; that the coating hardens like enamel after some months, possesses a dull gloss, does not blister in the sun, and is washable, yet retains its original smoothness. The paint is suitable for walls and woodwork of all descriptions.

AMATEUR WORK.

DRAPER PUBLISHING CO., Publishers,

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A Monthly Magazine of the Useful Arts and Sciences. Published on the first of each month for the benefit and instruction of the amateur worker.

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Single copies of back numbers, 10 cents each.

TO ADVERTISERS.

New advertisments, or changes, intended for a particular issue, must be received at this office on or before the 10th. of the previous month.

Entered at the Post Office, Boston, as second class mail matter, Jan. 14, 1902.

JULY, 1905.

Of late many inquiries have been received which have been of such a character as to necessitate a few limitations in the "Correspondence" Department. We cannot give advice as to the merits and commercial possibilities of inventions and patents, or the sale of same, nor can we furnish designs of dynamos, steam engines, or flying machines upon requests written upon postal cards. It is also necessary that inquirers sign their names, as we are not mind readers and cannot reply if we do not know who makes the inquiries. Also, many of the inquiries are of such a nature as to require correspondence on our part, and it frequently takes some little time to procure the desired information. It is our intention, however, to make prompt reply by direct letter when a stamp is enclosed for postage.

A few inquiries regarding the reliability of some of our advertisers leads us to state that no advertisements are inserted in this magazine which we do not believe to be quite trustworthy. We accept no advertisements of doubtful character; in fact, have been accused of being over scrupulous, and feel confident that our readers will have no cause for complaint in any dealings which result from any advertisement appearing in the magazine.

We expect to be able to announce in the next issue a premium offer which we feel confident will be welcomed by a large number of our readers:— A servicable, efficient telephone for *Two New Subscribers*. The talking efficiency of these telephones will be fully equal to those of much higher price. They will have ringing bell, watch case receiver, switch hook, etc, and be *well* made in every particular. They will be just the thing for connecting the homes of two friends, from house to stable, or similar uses. We know they will be fully satisfactory, and advise our subscribers who would like them to secure the necessary subscriptions from their friends, which can be sent in advance and the premium sent when ready.

Do not delay ordering a set of the bound volumes; they are going fast, and the supply of Vol. I. will soon be exhausted. The large amount of interesting and valuable information contained in these volume, makes their acquisition desirable while it is possible to secure them.

The steamship engineer carries great responsibility, and so much depends on him that any device that will facilitate his movements about the ship or aid him in his work is well worth installing. The "American Shipbuilder" suggests the need of elevators for the personal convenience of engineers in descending or ascending the 30 or 40 feet to and from the engine-room. The means of descent is ordinarily a slippery iron staircase where a firm grip, steady nerves and a sure foot are required to make it in safety. The elevator would cost little, as there is always plenty of steam or electricity at hand and plenty of room to spare.

Fir will grow at as great an altitude as 6700 feet above sea level, yellow pine at 6200 feet, ash at 4800 feet, and oak at 3350 feet. The vine ceases to grow at 2300 feet.

THE RUHMKORFF COIL.

JOHN E. ATKINS.

The amateur interested in electricity should make himself familiar with the various parts of a spark coil; it is proposed, therefore, while avoiding as far as possible electrical technicalities, to explain understandingly the principal features and functions of the coil.

The first step is to acquire a supply of electrical energy to produce the required current. Assume that one of the many forms of primary battery is selected—preferably new, dry cells. The next question is how the electrical energy, with which the amateur has supplied himself, is to be made to produce a spark by means of an induction coil.

The construction of the induction coil is based upon certain principles of electricity discovered years ago.

The first principle is:—With two entirely separate and distinct circuits placed near to each other, but not in contact, by exciting an electric current in one of them, there will be instantly induced, or in other words, produced by induction, an electrical current in the opposite direction in the other circuit. The original current is called the primary current, and the induced current is called the secondary current, and the circuit in which it is induced is called the secondary circuit. Similarly, if the current in the primary circuit is suddenly interrupted, a secondary current will be momentarily induced in the secondary circuit, but this time in the same direction as the primary current. It follows that, if you alternately open and close the primary circuit with great rapidity, thus alternately exciting and interrupting its current, there will be induced in the secondary circuit a current which is continually changing in direction; in other words, what is called an alternating current.

The second principle is:—That the rapid movement of a magnet in proximity to a conductor, or of a conductor in proximity to a magnet, will excite an electrical current in such conductor.

The third principle is:—That an ordinary bar of soft iron, which is for practical purposes non-magnetic, may be turned into a very powerful magnet—termed an electro magnet—by being placed in the neighborhood of an electric current, and that the magnetism so produced will last so long as the current continues.

Now, in the center of the Ruhmkorff coil is a core of soft iron wire around which the primary wire is wound, the effect of which is that directly an electric current is excited in this circuit the iron core becomes magnetized. The core is, in fact, instantly converted into an electro-magnet emitting lines of magnetic influence, and the immediate sphere through which these lines of magnetic influence pass is called the magnetic field.

The secondary coil, consisting of many thousands of yards of very fine insulated copper wire, is wound round the core and primary circuit in such a manner that it is continually passing through the magnetic field.

Fig. 1, while by no means showing the detailed construction, will serve to illustrate the principle upon which the primary and secondary circuits are respectively wound. The iron core is represented by *a a*. The thick line, marked *b b*, represents the primary circuit, the positive, +, and negative, —, terminals of which *A A* would be connected to the corresponding terminals of the battery. It will be seen that this primary circuit, *b b*, is wound round the core, *a a*, so that immediately the current is turned on the core will be magnetized.

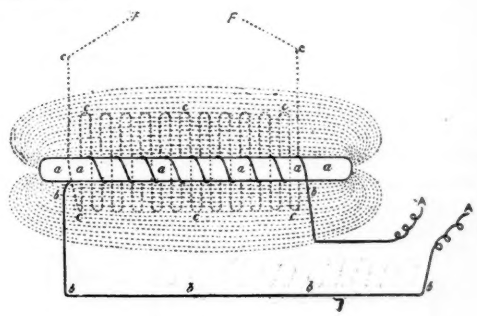

FIG. 1.

Owing to the proximity of this secondary circuit *e e* to the primary circuit *b b* the instant the primary current is excited in *b b*, a secondary current in the opposite direction is induced in *c c*, while the instant the primary circuit *b b* is broken or opened, a secondary current in the same direction is induced in the secondary circuit, *c c*.

In order to make the diagram plain, the secondary circuit is shown as passing only twelve times round the primary circuit and core, but in actual practice this secondary circuit is several miles in length, and is wound many thousands of time round both, in the form of a bobbin.

The horizontal lines in Fig. 1 represent the invisible lines of magnetic force caused by the magnetization of the core *a a*, and it will be noticed that by the arrangement above described, the secondary circuit, *c c*, is enveloped in this magnetic field; in other words, the secondary current is continually passing through the lines of magnetic force.

The foregoing is a mere outline of the principle of the construction of an induction coil, and the beginner will naturally ask how this apparatus operates to

intensify the force of the current supplied by the batteries.

The actual E. M. F. of the primary circuit remains in all probability unaltered, but the E. M. F. of the resulting secondary current is vastly increased from several causes. One cause is the great length of the secondary circuit, necessitating an enormous number of turns or coils. The greater the number of coils, the more frequently does the secondary current have to pass through the lines of magnetic influence, and the more often it passes through this magnetic field the more intense becomes the voltage.

Another cause is a contrivance by which the primary circuit is opened and closed, and the primary current consequently interrupted with great frequency and rapidity, thus constantly magnetizing and demagnetizing the core. We have already explained that the rapid movement of a magnet in proximity to a conductor will excite a current in such conductor. In the Ruhmkorff coil you are, by repeatedly interrupting the primary circuit, constantly magnetizing and demagnetizing the core; in other words, constantly producing a magnet in proximity to the secondary circuit, and immediately taking it away, an operation practically equivalent to the rapid movement of a magnet in proximity to the secondary circuit, the result being to excite a current in the secondary circuit.

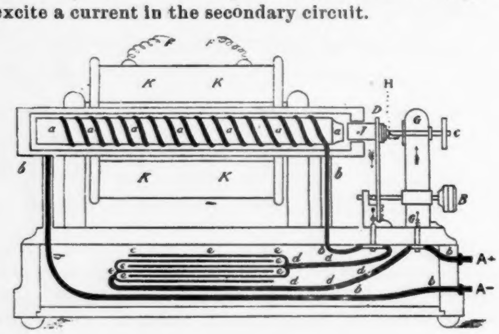

FIG. 2.

It will thus be seen that the secondary current is not only intensified by its constant passage through the lines of magnetic force, but also by the rapid magnetization and demagnetization of the iron core. It must also be remembered that the continual making and breaking of the primary current causes the secondary current to be constantly changing its direction, so that it is further intensified by being converted into an alternating current.

The device by which the primary current is thus interrupted is shown at Fig. 2. In Fig. 2, the primary circuit is closed. The current passes from the positive terminal, +, up the metal pillar, *G*, by way of the platinum points, *H*, to the hammer or contact breaker, *J*, down the spring of the hammer, *D*, and thence by way of the primary circuit *b b*, round the core *a a*, and back to the negative terminal, —.

A loop, *d d*, is shown which goes off to the condenser, *e e*, but if this is followed it will be perceived that the two parts of the condenser are not in contact, so that the current cannot circulate through this loop, the functions of which are described later.

Now, the moment the current is turned on, the core, *a a*, is magnetized, and, as a natural consequence, the hammer or contact-breaker, *J*, is drawn by magnetic attraction towards it. The immediate effect of this is to break the contact, or open the circuit at the platinum points, *H*. The result of thus breaking or opening the primary circuit is to demagnetize the core, *a a*, so that the hammer, *J*, ceases to be attracted, and is caused by the spring, *D*, to fly back to its original position, when the process is automatically repeated; the primary current being thus interrupted and the circuit opened and closed with wonderful rapidity.

It now remains to draw attention to the loop, *d d*, leading to the condenser. The reader will observe that this loop is not strictly a portion of the primary circuit proper, but a kind of extension of the circuit from the contact breaker. The condenser itself, *e e*, to which this loop leads, consists of several thin layers of tinfoil placed in the base or stand under the coil. Each layer is connected to the next layer but one, but is carefully insulated from its next-door neighbor. One set of connected layers is attached to the positive conductor of the loop, while the other set is attached to the negative. It will be seen from Fig. 2 that by this arrangement this loop does not form a complete circuit, there being no actual contact between the positive and negative layers; whereas, if they were connected, the primary circuit would not be opened or broken when the interruptions at *H*, which we have already described, take place, because the current could pass from *G* to *D* by way of *d d* and *e e*.

We have already explained that the making and breaking of the primary circuit induces alternate currents in the secondary circuit, and it is also a fact that the breaking of the primary circuit will momentarily produce by induction a current in the same direction in itself—a phenomenon which is called self-induction.

Now, the function of the condenser is to absorb this self-induced current which is formed in the primary circuit at the moment when such circuit is broken at *H*. When this break occurs, the current seeking a passage rushes to the condenser by way of the loop, *d d*, only to find that there is no contact between the positive and negative sheets of tinfoil which compose the condenser. The electricity thus accumulated by the condenser is discharged a moment later through the primary coil, thus creating a current in the opposite direction to the battery current, and consequently demagnetizing the core.

As the induced current is due to the change in the magnetization of the core, this demagnetizing current greatly adds to the efficiency of the coil.

Further, by thus absorbing the current, the condenser reduces the liability of the current to "arc" or

spark across the space between the platinum points at H when the contact is broken.

The important part which this condenser plays in intensifying the secondary current will be appreciated when we inform the reader that a 1 in. spark coil, without a condenser, will barely give a spark of $\frac{1}{8}$ of an inch in length.

To such an extent is the intensity of the secondary current increased by the devices which we have described, that if the secondary circuit is left open between the terminals F F, the current will be forced across the intervening space, and a continuous stream of sparks, like miniature forked lightning, will pass from one terminal to the other.

TECHNICAL EDUCATION.

The following are abstracts from an address, entitled "Commerce and Culture," delivered by Sir Swire Smith, a leading English authority on industrial art and technical education, on the occasion of the distribution of prizes Dec. 19, 1904, at the Central Municipal Technical School of Liverpool, England. The report was transmitted by United States Consul Boyle, of Liverpool:

The best spent money is that which is spent in cultivating the brains of future rate payers. You seem to have shown a determination in your educational agencies to give equality of opportunity to rich and poor alike, so that talent, wherever it may be found, may be available for the enrichment of the community. The object of education has been defined as the fitting of the people for their work in life and for their duties as citizens.

All realize that in the future the greatest success in the world's commerce will be achieved by that nation which can make the most effective use of education, science, machinery and available advantages, and thus can place upon the shop counters of the world the commodities that the world wants. I have had, in my experience, exceptional opportunities of comparing, face to face with the facts, the resources and the aids which count for success in manufacturing industries in the leading countries of the world. I am fully acquainted with the many difficulties with which British manufacturers have had to contend in their competition with foreign rivals. I know something of the effect of the lower wages and longer hours of competing operatives in other countries, and of other factors that have influenced the competition.

In the world's race for commerce we are meeting competitors equally armed with weapons of precision. Our position will depend on our national supply of "brains and brawn," and how we can best utilize them for the public service. The more I see of the progress of other countries the more do I realize that education is the main factor in the competition that lies before us; in proportion as we can raise the individual efficiency of our people, in that proportion shall we hold our own. Some of our industries may be harassed by what we call unfair competition, but we must take consolation from the fact that those nations do not permanently hurt us that compel us to put forth our best. New markets are ever opening up, new wants are arising.

We can no more compel our customers to buy what we wish to sell than the angler can compel the trout in the stream to take the fly he casts. More than ever our manufacturers will have to cater for two important classes of customers—the million who must have cheapness, and the tasteful and wealthy who demand excellence—you find the characteristic productions of our industries represented by the labor of quantity and the labor of quality, in both of which we are destined to stand or fall against the world. In the labor of quantity, in supplying the goods for the millions, in which we have so long been supreme, we must be first in the adoption of all machinery and methods that will insure economy of production. Young men will have to enter the world with open minds, ready to learn all that can from all sources, and to apply what they learn. In spite of all obstacles there is still, especially in the neutral markets, an immense field open for the trade in common goods for the million, which offers success and fortune to those who enter it with knowledge and with a determination to suit the convenience and taste of the buyers. As for the labor of quality, represented by excellence in the manufacture of superior goods and luxuries, every market in the world is open. It can only be secured by the greatest taste in designing, by the finest knowledge in applying science to industry, and by the most highly trained skill and workmanship. Success in this field means the capture of many prizes now held by our rivals, and the development of industries of enormous value to our home market, as well as to all the wealthy markets of the world.

For more than thirty years I have been intimately associated with the education of my own town, and more particularly with its technical school, through which several thousands of students have passed. Living among them, I have watched the career of many, and can testify to the soundness of their education; yet I confess that some of the most brilliant students and prize winners have not fulfilled the promise of their youth. They have been lacking in grit and energy, some of them looking upon education not as a means to an end, but as an end in itself. I have also known others who, by perseverance and character have

turned a little learning to good account in many ways and have become leaders of men. I have seen youths and maidens come to the evening classes in science and other subjects, with a slender equipment of scholastic knowledge, who have soon learned how to learn, and have had implanted in their minds a genuine love of knowledge. And I wish to say in defense of this so-called "bread and butter education," that whatever may be the ultimate object in view of the student, all true education leads to culture. I have known scores of students from the humblest ranks who passed from the half-time factory schools to evening classes who obtained scholarships to the highest colleges and universities, and are now worthily recognized as men of culture.

I have found among the apprentices from machine shops and factories many whose first idea in attending an evening class was to obtain knowledge that they could turn to practical account in the daytime, but who, after receiving advanced instruction in science were lured to the Elysian fields of literature beyond. Many a student whose habits of study have been formed under the stimulus of bettering his material condition, has been led to seek the solace and pleasure that he could get from books that elevated his moral character and contributed to the refinement of his nature. And when we consider the influence of such young men among their associates in the workshops and in mellowing their hearts while they are strengthening their faculties as men of affairs. Thus it is that in considering the broad question of education to the millions who start out in life with no inherited capital but that in their brains and sinews, I am strongly of opinion that the education imparted in such a school as this is not only most fitting in itself for their industrial training, but in most instances it forms the best foundation for the extension of culture, and often acts as a stimulus toward its attainment. My advice, therefore, to the students who are before me is this: "Seek ye first the necessaries of education, and the luxuries will be added unto you."

You will have noted that a controversy has been going on for some time as to the importance of the teaching of Greek in our old universities of Oxford and Cambridge. I do not think that you and I need to be seriously concerned about this question. I am reminded of the mischievous schoolboy at Eton who wrote on the door of the classical professor, "This road leads to nowhere." When the professor saw the inscription, he wrote underneath it, "Nevertheless, a good road on which to take exercise"—surely a terse and witty answer. But the answer reminds me of another story of a wealthy manufacturer, and one of the pioneers of the wool industry of Bradford. He had contracted some ailment, and he called in his medical man, who prescribed that he should get some dumb-bells and take vigorous gymnastic exercises. "But," asked the patient, "would not exercise in my factory do as well for me?" "Quite as well," replied the doctor. And this rich manufacturer could be seen perspiring among his workmen, packing the bales of pieces and loading them on to the wagons. He said he "didn't believe in doing work that didn't bring something in." Your technical instruction, like Greek, will give you good exercise, and yet, unlike Greek, will bring something in.

I have no fears that this country will suffer in its higher interests from too much attention being paid to the utilities of life. It is not so much what a young man learns as the spirit in which he enters upon his studies that determines the formation of his tastes, and culture is the bourn toward which the searcher for knowledge is ever tending, no matter in what field that knowledge may lie. I heartily accept Mr. Ruskin's definition as upholding the line which I have presumed to take on this question. He says, "Education briefly is the leading of human souls to what is best, and making what is best out of them; and these two objects are always attainable together, and by the same means; the training which makes men the happiest in themselves also makes them most serviceable to others. I believe that what is most honorable to know it is also most profitable to learn, and that the science which it is the highest power to possess it is also the best exercise to acquire." Emerson taught that the acquisition of some manual skill, and the practice of some form of manual labor, were essential elements of culture, and this idea has been more and more accepted in the systematic education of youth."

PRACTICAL EDUCATION AND LITERARY CULTURE.

As to the bearing of practical side of education on literary culture, Mr. Henry Smith Williams, in an article on the Literature of Science, shows by remarkable examples that some of the greatest masters of literary style have been men of scientific training. I select the following among many:

"Buffon, famed a century ago for his mastery of literary style, was by profession a naturalist. Dante was learned in every phase of the known science of his time. Keats, 'one of the few writers of his time whom critics have ventured to mention in the same breath as Shakespeare,' was trained in the profession of medicine. Goldsmith was a practicing physician; so also was Schiller, the second poet of Germany. Goethe, 'whose genius raised the German language to a new plane as a medium of literary expression,' would be remembered as a discoverer in science had he never penned a page that can be called literature. Darwin's Origin of Species owed much to the form of its presentation, but much more to the greater artist. Huxley, in Man's Place in Nature, and in a score of other essays, brought all the resources of a marvelously flexible literary style to the aid of the equally revolutionary doctrines that Darwin had inaugurated. It is well to remember also among the teachings of history that material prosperity in the true development of civilization must go hand in hand with intellectual cul-

ture, and none have more ardently desired the spread of the latter than those who were in their day the great economic pioneers of the former."

Earl Stanhope said that:

"In Athens the study of the arts and the acquirements of literature were united and made to flourish by the pursuits of commerce. For while these great speculations in philosophy were being pursued in the grooves of the Acadamy, and while Phidias was raising the masterpieces of his art—at that very time ships from every clime then known were crowding the wealthy ports of the Piræus."

Your own illustrious townsman, William Roscoe, so long ago as 1817, at the opening of the Liverpool Royal Institution, in an eloquent discourse, remarked:

"We find that in every nation where commerce has been cultivated upon great and enlightened principles a considerable proficiency has been made in liberal studies and pursuits. * * * Under the influence of commerce the barren islands of Venice, and the unhealthy swamps of Holland, became not only the seats of opulence and splendor but the abodes of literature, of science and the fine arts, and vied with each other not less in the number and celebrity of eminent men and distinguished scholars than in the extent of their mercantile concerns."

Lord Beaconsfield, in an address to the students of the Atheneum at Manchester, sixty years ago, declared:

"It is knowledge that equalizes the social condition of man, that gives to all, whatever may be their political position, passions which are in common and enjoyments which are universal."

Here is the testimony of the great Lancashire man, who was described by Mr. Gladstone as the "inspired bagman." In 1844 Er. Richard Cobden said:

"There will be one test for the future greatness of Manchester, and that will be a mental test and not a material test—that our destiny will be decided, not by the expanse of bricks and mortar, not by the muliplication of steam engines, nor by the accumulation of wealth, but just in proportion as mental development goes forward, and in proportion to the development of wealth and mental resources, just in the same proportion will our destiny be exalted or the very reverse."

At Manchester also, in 1847, the second great apostle of the "Manchester School," Mr. John Bright, spoke in a similar strain. After enumerating some of the examples of the commercial progress of the country, he asked:

"With these increased comforts and advantages that we enjoy, shall we neglect that which is most noble because it is the indestructable portion of our being? Shall we be victors in the material world only and gain no laurels in the intellectual? Or shall we dive to the deepest depths and soar to the loftiest heights; growing in mental stature and adding to all those outward blessings that surround us—yet neglect those which are purer and more lasting and which spring up as a rich harvest from the culture of the mind?"

Here we have the loftiest and most eloquent tributes to culture from the most eminent promoters of trade and commerce that this country has produced. I could give many others, but I will content myself with a brief appreciation of this same culture by the greatest industrial leader and the most generous friend of technical education of our time—nay, of all time—Mr. Andrew Carnegie. In his rectorial address to the students of St. Andrews he said:

"Of what value is material compared with moral and intellectual supremacy—supremacy not in things of the body, but in those of the spirit? What the barbarous triumphs of the sword compared with those of the pen? What the action of the thews and sinews against that of godlike reason, the murdering savage armies of brutal force against the peaceful armies of literature, poetry, art, science, law, government, medicine, and all the agencies which refine and civilize man, and help him onward and upward?"

An so, to sum up, I rejoice in the assurance that the technical and scientific training which this great school is imparting to you is not only providing each of you with working capital that can be utilized in the development of the industries of Liverpool, but is "leading your human souls to what is best" in the cultivation of your higher intellectual faculties. We sometimes speak of Britain as the "old country," as if it had seen its best days and was entering upon its period of decay. It is venerable in years, and perhaps it clings rather tenaciously to some of its old-fashioned customs and ways; but it retains its vigorous strength, its love of freedom, its unbounded energy, its doggedness of purpose, and there has been no falling away in the breed and stamina of its people. It is when we see the young men and maidens of our country gathered together as they are here tonight that, as Burns says, "Hope springs eternal on triumphant wings," and we feel assured of the enduring qualities of our race and of the perpetual youth of our country.

Where it is impracticable to thoroughly drain the swamp regions, says "Aboriculture," an improvement may be effected by planting willows and other growths which emit roots readily from cuttings, and many of these are of greater valve than existing swamp trees. Willows reduce the malarial gases and thereby improve health conditions. They evaporate vast quantities of water through their leaves and absorb carbonic acid gas from the atmosphere, thus drying up the moisture and purifying the air. Some of the willows are valuable for a number of uses. Charcoal for powder is best made from willow. Salicylic acid is a product of willow bark and is very largely used in pharmacy. Artificial limbs are preferably made from willow, which combines great strength with lightness.

MARINE GASOLINE MOTORS.

THEIR DESIGN AND OPERATION.

By Courtesy of the Brooks Boat Mfg, Co.

LUBRICATION.

A gasoline motor requires ordinary intelligent care. It should be kept clean internally and externally. Grease and dirt form conductors, injure the insulation. See that no foreign substance enters the fuel tank, as a small particle will obstruct the needle valve. It is a good plan to have a gauze strainer in the funnel used to fill the tank. Never use ice for cooling parts that have become heated—cool gradually. Use a high grade gas engine oil for cylinder. This is a high fire test mineral oil—animal oils will not do.

A good grade of machine oil is suitable for shaft bearings and other working parts, or still better, use compression grease cups on all the main bearings.

If the motor lubricates the connecting rod by the splash system, the crank chamber should be supplied with "crank case oil." All parts must be oiled sufficient for lubrication. Beyond this, an excess of oil is a detriment, resulting in an accumulation of grease about the motor besides forming a gum that clogs the openings to the cylinder, the rings of the piston and the spark points.

HINTS TO THE AMATEUR OPERATOR.

There are four important points that the operator must attend to. First, the ignition; second, the mixture; third, the lubrication, and fourth, the water circulation.

To start the motor you will first see that there is a supply of fuel in the tank, then open the valve next to tank and also give a vent to the tank. Open the gasoline valve next to vaporizer and the needle valve of the mixing device. Open the relief cock of the cylinder and give the fly-wheel a couple of turns in the direction motor runs, adjust the ignition to take place at the top of the stroke, close the relief cock, throw in the switch and give a quick turn to the fly-wheel. The motor will then start. You must now advance the spark and if dynamo is used, switch current from battery to it. See that pump is working and adjust oil cups to give proper supply.

It will be found that to start the motor when it is cold will require an extra amount of gasoline, but as the cylinder becomes warm the supply can be reduced to the proper point. Less gasoline is required in warm than in cold weather. Keep watch of the sight feed oil cups until they become warm, as the oil will then run more freely. Adjust the cylinder cups to feed from 6 to 7 drops per minute. To check down the motor, shift the lever so as to retard the spark. If the slow speed is to be continued any length of time, reduce the supply of gasoline accordingly.

To stop the motor—throw off the switch, turn off the supply of gasoline at the stop-cock and needle valve, shut off the oil cups, and when leaving the boat shut off the gasoline at the tank and close the vent.

LOCATING TROUBLE.

If, after a proper trial the motor fails to run, first examine the spark. If make and break is used, test by turning the fly-wheel until the points or electrodes within the cylinder are brought in contact, then detach the wire from the stationary electrode and pass the end of the wire across its post and see if there is a spark. If the spark shows all right, turn the flywheel until the electrodes are separated and try again in the same way. This time there should not be any spark. If jump spark is used, disconnect the wire and take out the spark plug, reconnect the wire and lay the spark plug on top of the cylinder in such a position as to ground the metal part with the cylinder, then turn the flywheel until the circuit is formed, when a spark should show between the points of the spark plug.

If no spark occurs with the make and break, look over the insulation of the wires and all connections. See that no wire is broken under the insulation and that connections are firmly made. Ascertain if the battery is weak.

WEAK BATTERY.

When a motor stops or refuses to start, nine times out of ten the trouble will be found with the spark. When a battery alone is used to furnish the spark, it will in time become weak and useless. A weak battery will recuperate and show a good spark, but this will not last. A few sparks will exhaust it and then a rest of a few minutes will again recuperate it sufficient for a few more sparks.

This often puzzles the amateur, as he will try the spark and apparently it will be all right, and at the same time the motor will stop after three or four revolutions. Therefore, when testing the spark for weakness, try it by repeatedly sparking it for at least a minute to ascertain that the spark holds its strength. Never add new cells to an old set of batteries to strengthen them, as one old, weak cell will bring down the new ones to its strength or voltage.

In all except small cylinder motors a dynamo should be used to give the current, the batteries only being used to start with.

If no spark occurs with the jump spark, look over the insulation wires and spark coil, and see that the vibrator is adjusted properly, see that the insulation or porcelain of the plug is not cracked, and that the

points are clean and not over 1-16 of an inch apart. If the spark is not at fault, then look at the mixture. This may be either too rich or too poor in gasoline or the compression of the charge may not be perfect. A mixture that is too rich will cause a smoky exhaust, resulting in fouling the cylinder electrodes and valves. A mixture too poor will not ignite regularly and is apt to be slow firing, which is one of the causes of back firing. After the valves of the mixing device have been once adjusted to give the proper mixture, they should be marked in this position.

COMPRESSION.

If the cylinder leaks or loses its compression through a leak, it will result in a loss of power or may cause the motor to stop. A two cycle motor may leak past the piston if the rings become fouled or worn, or it may leak at the spark plug. A four cycle motor leaks compression at the intake or exhaust valves. These are liable to leak through becoming corroded, and when found in this condition they should be removed and ground to their seats with emery flour.

WATER CIRCULATION.

Should the pump stop working and the cylinder become hot, stop the motor and let it cool gradually. Never put water in while the cylinder is overheated. If you have been using dirty, muddy water, the sediment is liable to clog the water, to clog the water jacket and cause trouble unless removed. In freezing weather draw off the water from the cylinder, pipes and pump—otherwise they will be broken.

SOME POINTERS.

Do not fill the gasoline tank near an open lamp.

Strain the gasoline before using it.

Remember to give vent to tank.

Do not permit any joints or valves to leak.

If motor is two cycle and compresses in the base, see that the base is tight.

If make and break sparker is used and causes trouble see that the spring is not cracked or broken, or that the moving electrode is not bound by becoming overheated or from a lack of lubrication.

Use kerosene oil to clean out a fouled or gummed cylinder—gasoline will not do.

If jump spark is used, see that the porcelain is not cracked, or that the points are not fouled.

Use 76° test gasoline—never lower that 74° test.

Do not feed too much gasoline—Do not feed too much cylinder oil.

Do not forget to drain cylinder, pump and pipes in freezing weather.

Remember that a leak of any kind at any place is detrimental.

FOUNDATION.

Some of the smaller makes of motors require only two foundation timbers which are placed athwartships (right angle to keel), and the bed plate is bolted directly to these timbers. Most motors, however, are fastened to two fore and aft timbers that are placed on top of the athwartship timbers. The athwartship timbers are notched over the keel and shaped to fit the inside of the planking. These timbers are bolted to the keel and the planking is nailed to the timbers from the outside. The top of the foundations is trimmed to conform with the line of shaft. A very simple way to line up a small motor is to first put in the outboard shaft and stern bearing, and then so shape the top of the foundation as to bring the crank shaft in line with the outboard shaft.

FUEL TANK.

This should be of copper or galvanized iron. The latter is commonly used and is perfectly satisfactory. Be sure the tank does not leak. If it is of over ten gallons capacity, it should be made with two or three compartments or partitions placed fore and aft with a small opening in the bottom of each. This prevents the contents shifting with every list of the boat. The fuel tank should be placed on a shelf close up under the forward deck, and be provided with a suitable opening on deck for filling. This opening should have a pin hole vent. The tank should be connected with the motor with either block tin or lead pipe and a shut-off valve be placed both next to the tank and next to the motor. An ordinary glass water gauge may be connected so as to show at a glance the amount of fuel in tank. Brass fittings should be used to connect up gasoline piping and the unions of such fittings have ground joints that need no gasket. If, however, you should use iron unions, make all gaskets of leather, as ordinary rubber or composition packing will not stand. Use shellac or common soap on the threads when putting gasoline piping together. To figure the capacity of fuel tank, allow one gallon of gasoline per h. p. of motor for ten hours running.

MUFFLER.

The muffler is an expansion chamber attached to the exhaust, used to deaden the sound. It is usual to place this under the after deck. In small boats it is sometimes placed next to the motor with the exhaust outlet directly through side of boat. The water from the motor may be piped into the exhaust pipe so as to flow through the muffler and overboard. The advantage of this is to keep the exhaust piping cool. It, however, has this objection, that the water partly turns to steam, which makes the exhaust always visible. When the water is piped into the exhaust, the exhaust pipe must slant down from the motor to the point of discharge—otherwise the water would flow back into the cylinder when the motor stopped. The exhaust pipe and muffler should be covered with asbestos covering. This covering may be finished with brass bands and painted with aluminum paint.

If jump spark ignition is used, the batteries and spark coil must be placed in a locker so that they may be kept dry. The jump spark requires a high tension current that must be carried to the spark plug with a special insulated wire. This, however, is furnished by all motor manufacturers.

BOOKS RECEIVED.

SPANGENBERG'S STEAM AND ELECTRICAL ENGINEEING. IN QUESTIONS AND ANSWERS. E. Spangenberg, M. E.; Albert Uhl, A. I. E. E., and E. W. Pratt. 672 pp. 8½ x 5½; 643 Illustrations. George A. Zeller, St. Louis, Mo. Price, $3.50. Supplied by AMATEUR WORK.

As indicated above, the method of presenting the various topics included in this book is by means of over one thousand carefully prepared questions and answers, but in addition are to be found extended sections treating many important subjects in a more complete way than by simple answers. The authors are experts in their several lines, with the additional ability of being able to impart their knowledge in a very interesting and readable way. An additional section of 83 pages treats of the locomotive; compressed air, gas and gasoline engines, mechanical refrigeration, hydraulic elevators and repair work have separate sections, making the book a valuable one to those interested in these subjects.

SPANGEFBERG'S PRACTICAL ARITHMETIC, SELF TAUGHT. E. S. Spangenberg, C. E. 228 pp. 5¾ x 4. George A. Zeller, St. Louis, Mo. Price, 50 cents. Supplied by AMATEUR WORK.

This book differs materially from the ordinary arithmetic, and to its decided advantage in view of the fact that it is written especially for self instruction. Special attention has been given to practical methods of calculation, familiar to all who make frequent use of mathematical processes, but rarely taught efficiently in the grammar schools. Any one requiring a book for review or for first instruction will find this one of great value; the size making it convenient for the pocket.

MODERN ELECTRICAL CONSTRUCTION. Henry C. Horstmann and Victor H. Tousley. 243 pp. 6½ x 4½. 138 Illustrations. Flexible leatner. Price, $1.20. Frederick J. Drake & Co., Chicago, Ill. For sale by AMATEUR WORK.

It is intended in this book to provide the beginner in electrical construction work with a practical guide; one that will tell him exactly how to install his work in accordance with the latest approved methods. In accordance with this idea the rules of the "National Electrical Code" of the National Board of Fire Underwriters have been used as a text in connection with which there is interspersed in the proper places a complete explanation of the work by which the rules apply, remembering in this the method by which many successful, practical workmen have learned the trade. An excellent book for all electrical workers.

DECORATIVE PHOTOGRAPHY. No. 68, Photo Miniature, Tennant & Ward, New York.

Gives detail directions and excellent illustrations of decorative work in photography. Of particular interest in illustrating, menu and program decoration, advertising, etc.

ELECTRIC PURIFICATION OF DRINKING WATER.

The Frankfort "News" states that it is probable that electric purification of drinking water will soon be introduced into the home. This method, already used by a number of municipal waterworks, is based upon the germ-killing effects of ozone, which is cheaply engendered by electricity. If an electric discharge takes place between two glass tubes, one inside the other, whose surfaces facing each other are coated with metal, ozone is developed in the space between the tubes.

Electricians have tried in recent years to simplify the means of electric ozone for purifying water. The ideal apparatus would be one which every housekeeper could put up in the kitchen, and by utilizing the electric current of the common electric-light wires purify every glass of drinking water. According to the "Frankfurtnr Umschau," such an apparatus seems to have been successfully made by a French engineer, Mr. Otto.

The apparatus is of very simple construction and takes up little space. It consists principally of a small closed box, the metal cover of which is made conductory with the bottom. In the box is an ozone developer, an interrupter and a tin tnbe. Through the latter the ozone, which first has to pass through a cotton stopper to free it from dust and germs contained in the air, is conducted into the water and mixed therewith. If much ozone has become absorbed, the water becomes phosphorescent in the dark. The most important part of the apparatus is the "mixer," action of which can be interrupted at will. The apparatus is capable of purifying about 60 gallons of water an hour and the cost is about the same as that of an ordinary electric incandescent light.

Some years ago the Furness Railway in Great Britain unfortunately had a mail train blown from the track by the fury of a winter gale. The train was thrown over the Levens viaduct and nearly fell into the sea. With the idea of preventing the recurrence of a similar disaster, the railway company installed an instrument which automatically warns the signal men stationed at Clark and at Plumpton when the wind pressure on the viaduct reaches the danger point.

The apparatus has been placed on the western side of the structure, and is a wind pressure gauge with suitable recording apparatus. Not only is the wind pressure constantly recorded, but the device has the further function of warning the signal man when the wind is too strong for the safe passage of trains. The warning it given by the automatic ringing of bells in in the signal towers. The bell rings steadily as long as the dangerous velocity of the wind keeps up, and all traffic over the viaduct is absolutely stopped. When the bells cease ringing it indicates that the fury of the wind has subsided and that traffic may be resumed with safety.

THE METAL WORKING LATHE AND ITS USES.

ROBERT GIBSON GRISWOLD.

III. Screw Cutting—Kinds of Threads.

The two threads in principal use in this country are the sharp "V" thread and the Sellers or U. S. Standard thread. The former, shown in Fig. 1, is the one most readily cut. It has many disadvantages, however, chief among them being its liability to injury owing to the very sharp points. When these are battered it becomes very difficult to run the nut on and stripping may result from forcing.

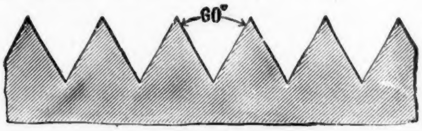

FIG. 1.

In cutting the "V" thread in the lathe, the work is first swung on the centers. The thread tool is then ground so that the two sides of the point form an angle of 60°. This is generally tested and determined by using a thread gauge, as shown in Fig. 2.

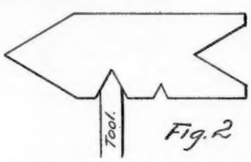

Fig. 2

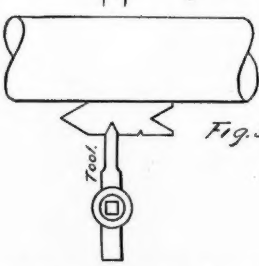

Fig. 3.

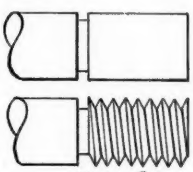

Fig. 4.

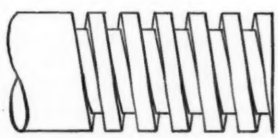

Fig. 8.

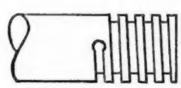

Fig. 5.

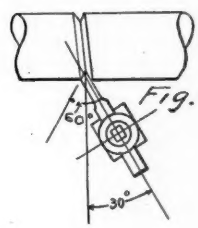

Fig. 6.

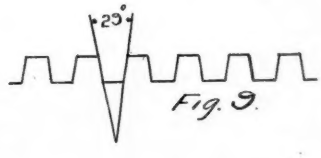

Fig. 9.

When properly ground and the edge properly stoned for smooth cutting, the tool is set in the tool-post by aid of the thread-gauge, as shown in Fig. 3. One edge is placed in contact with the work, and the tool is then adjusted so that the point exactly fits the "V" which insures the proper angle between the sides of the thread and the axis of the work.

The point of the tool is now brought into contact with the surface to be cut and the thread-stop on the cross-slide set. A light cut is then run along for the proper length of thread, and the number of threads per inch counted to determine if the gears have been properly set.

In many lathes it is necessary to reverse the lathe to return the tool to the beginning of the thread, but some of the later models are being provided with an attachment operated by a reversing lever placed in the apron. This renders unnecessary the reversal of the lathe and the tool will catch the thread at any position. In the ordinary lathe this is almost impossible since, if the tool is removed from the cut and returned to the start by hand after releasing the nut, the exact position on the lead screw for closing the nut may or may not be readily found. And besides it is almost as quick to reverse the lathe and let the lead-screw carry the tool back.

A very important caution is to always back the tool out from its cut so that it will not drag on the return. If this is not done the point will invariably be broken off, as it has no support on the top side. While the tool is being returned the gauge is set so that the next cut will be slightly deeper. Never attempt a very heavy cut with this tool as the point is not strong enough. As it is, the most delicate portion of the tool is exposed to the hardest work.

The proper depth of cut may be readily determined, as the tops of the threads will become perfectly sharp, but it is better to try a nut on the thread and thus ascertain the fit. At the root, diameter may be measured with a pair of calipers made for the purpose.

A beginner may experience some difficulty in withdrawing the tool at the end of the cut without snapping off the point. If possible, it is much better to cut a groove in the piece at the end of the threaded portion into which the tool runs at the end of its cut. This is shown in Fig. 4. This in no way weakens the

piece, as the root diameter of the thread and the groove are the same.

In very large threads, and especially with square and acme threads, the thread groove often terminates in a hole drilled in the piece as in Fig. 5, which gives the tool an excellent chance to finish a good thread and back out.

There are several lubricants used in screw cutting, but lard oil is quite as good as any. Solutions of soda and soap are often used with good effect, and are cheap.

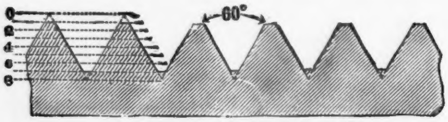

FIG. 7.

A thread tool is seldom allowed much top rake, owing to difficulties in setting, and its cut is thus necessarily of a scraping nature. A keen edge is necessary at all times to prevent making a rough thread. Sometimes a tool, such as shown in Fig. 9, is used where a compound rest is fitted. The point is ground to a 65° angle, and the slide is set so as to feed the tool to the work at an angle of 30°. All the cutting is thus done with one side, similar to a cutting-off tool. With care a very good thread may be made, but one side is likely to show the path of the tool point and must be cut smooth with a final chip.

The U. S. Standard thread or Sellers thread is a modification of the sharp "V" and is shown in Fig. 7.

The fact that the outer point of the sharp "V" thread had little strength, was liable to injury, and also that the sharp corners at the root of the thread had a tendency to weaken the bolt, led to the adoption by the U. S. Government of the Sellers system, sometimes spoken of as the Franklin Institute standard. As shown in Fig. 7, the top of the thread is flattened and the bottom of the groove is filled in parallel to the axis by an amount equal to one-eighth of the pitch of the thread, or the slant side of the original "V". The advantages of this thread are at once obvious. It is less liable to injury and the bolt is much stronger since the cross-sectional area is greater than that provided by the sharp "V" thread. The bearing area of the thread is lessened somewhat, but that is seldom a matter of importance in this thread.

The tool for cutting this thread is set in exactly the same manner as that used for the "V" thread, but in grinding it the point is flattened by the correct amount. Every different thread requires a special tool, owing to the varying widths of flats. In the case of sharp "V" thread one tool would cut any one of the many sizes.

The Whitworth thread, shown in Fig. 10, is the English standard and seldom seen the United States. The included angle is 55° and the top of the thread is rounded. The bottom of the groove is also rounded, and in this respect it resembles the U. S. thread.

With all threads made with angular sides there is a tendency to split the nut when a strain is put upon the bolt and to obviate this the trapezoidal thread is used in many instances where great loads are to be sustained. The breech blocks of the modern United States Navy guns are mostly fitted with this thread. It is shown in sections in Fig. 8, and is merely a V-thread turned a little to one side so that the load will be taken on the flat side of the thread. It has this advantage over "V" and square threads. There is no tendency to split the nut under load in the former case, and the resistance to stripping at the base of the thread is about twice that of the square thread. Its principal drawback lies in its inadaptability to resisting strains in both directions, owing to the great bursting pressure that would be placed upon the nut.

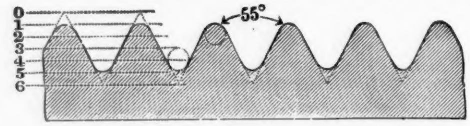

FIG. 10.

The square thread, shown in Fig. 8 is principally used for such purposes as lifting screws in jacks and machines and almost universally for the lead screws of lathes. It presents a flat wearing surface in either direction of resistance, but as stated above, has only half the strength of a "V" thread in shearing resistance. In cutting a square thread in the lathe. the tool must be of such angular shape as to follow in the groove cut. It frequently occurs that more than one thread will be cut on the screws, in which case we have double, triple and even quadruple threads. The pitches of the threads in these cases are just two, three or four times the single pitch, and one thread is cut between the turns of the others. These multiple pitches are mostly used where a considerable movement of the nut is required per revolution of the screw. The chief drawback to the square thread is its cost. Aside from the care required in its cutting, it necessitates very careful fitting, which is a tedious operation.

The Acme thread, shown in Fig. 9, has been designed to overcome some of the objections to the square thread and incorporate some of the good features of the "V" thread. The included angle between the sides is 29°, and the threads partake somewhat of the general cross section of the U. S. standard thread. The nut bursting tendency is not so great as the 60° "V" thread, and the shearing area at the base of the thread is greater than that of a square thread of like pitch. Owing to the taper of the thread it is less difficult to make a good fit.

In cutting threads on pieces of comparatively small diameter and considerable length, a back rest must be used to prevent the thrust of the tool springing the work and making the root diameter of the thread larger in the middle than at the ends.

PATTERN VARNISH.

C. C. BOSWORTH.

Every pattern-maker with any regard for his reputation loves to see the object of his skill leave his hands with a luster and without a scratch or blemish, and what is his consternation to see the molder, when he receives the same piece of work, take sandpaper, and that not always the finest grade, and go over this artistic piece of work to his own satisfaction.

We learn from this that those who use the patterns look upon the finish from another point of view, viz., that of utility instead or appearance, which is, after all the right view. Yet, at the same time, I do not wish to discourage any one in his efforts to produce a nice looking pattern. I wish only to show that it is a matter of secondary importance, the first being that of a hard, smooth, impervious coating which will leave the sand with little resistance and wear well. The ordinary orange or yellow shellac, which is best flake shellac dissolved in either grain or wood alcohol (but never in a mixture of the two), seems to be generally accepted as the most satisfactory varnish for a pattern, filling, as it does, the requirements named.

The ready-made shellac varnish varies in quality. The writer has known it to be of such a nature as to be apparently dry, and at the same time when put in the sand, the latter would adhere to the pattern to the extent of making it impossible to use, and no length of time in drying seemed to help the cause, and hence this varnish had all to be scraped off. Then again in making colored varnishes one mnst be careful in the selection of the coloring powders; for instance, in making black varnish, which is simply the yellow made black by the addition of lampblack, some grades of which when rubbed between the fingers are smooth and velvety to the touch, while other grades are gritty, and this latter will give a very unsatisfactory surface, with the best of care, and has but little gloss. Varnish, as its name implies, is a resinous liquid, laid on work to give it a gloss, but this gloss to a great extent is dependent upon the under coating and then upon the body and composition of the liquid. The under surface must be hard and smooth. We are all acquainted with the fact that the first coat of shellac laid upon the pattern gives it no luster at all, and this is even true of the second coat if the varnish used is very thin; it is absorbed by the grain of the wood which swells and raises its fiber, giving a rough dull surface, but after the pores of the wood become filled by the successive coats, each coat being rubbed lightly to a smooth finish with worn and fine sand paper, we notice that the succeeding coats become more glossy. When his varnish is thinned out too much it is possible to get but little gloss, as there is not enough of the resinous composition left on the surface, after the alcohol has evaporated, to give it a sufficient new body.

And again, if varnish is too thick there is not enough of the alcohol to float the resinous component, hence it cannot spread itself out evenly on the surface, hence it will appear mottled and when dry will even feel uneven, though glossy. When in this condition it is hard even to rub it to a smooth finish, in fact, it is worse to use varnish too thick than too thin. When a pattern is varnished often with shellac which is too thick it will crack and come off in flakes, bringing off all the successive coatings down to the wood, which makes the pattern hard to draw, and it has to be scraped; therefore, if the pattern maker would be careful in the selection of his materials, obtain a good surface and a medium body to his varnish, he will have all the gloss he desires after the third or fourth coat.

Now, in obtaining a good hard surface, I have known patterns that were to have constant use to be given a first coat or two of lead and oil for a filler; this gives a surface as hard and smooth as stone.

I have also known copal varnish, the outside kind, sometimes known as spar varnish, to be used where a specially glossy finish was wanted. Of course it must be applied to a good, dry, hard surface, and it takes several days for each coat of copal varnish to dry, but it wears well.

Oxalic acid is sometimes used to clear varnish. A teaspoonful will clear a quart of muddy varnish and give it a good clear color, but I do not like to use it as it is very poisonous. The writer once saw a man who nearly lost his arm by its use. He had a cut on his hand and got some acid treated varnish on it, the result being blood poisoning, much pain, and nearly the loss of his arm.

In fact, any shellac varnish should not be used on a cut, as is often done, as it is well known that wood alcohol is a poison of itself.

To keep varnish clear, I prefer keeping it in a porcelain cup or crock, well covered. Do not keep shellac varnish of any color, even black, in a galvanized can; it ruins the varnish.

As to pigment for red varnish, I find that indian red answers the purpose well, though of course it is not quite so brilliant as vermilion.—"The Patternmaker."

Investigation of fuels by the United States Geological Survey has shown that a ton of bituminous coal is capable of producing two and a half times as many heat units when producer gas is made from the coal as when it is burned in the usual way in the fire box of a boiler.

CORRESPONDENCE.

No. 96. East Orange, N. J., June, 2, 1905.

I have a small 1 in. induction coil which I recently purchased, and wish to know if same is good for wireless communication over water for two miles? If not, how far?

What do coherers sell for generally at the stores?

J. F. S.

A good 2 in. spark is sufficient for the distance you mention, provided you have a sensitive receiver and aerial wire at least 25-feet high; also a good ground connection at each station.

Coherers are catalogued generally at from $3.50 to $6.00, according to sensitivity and reliability. Address any of our electrical advertisers for price lists.

No. 97. Fort Collins, Col., June 9, 1905.

Are dry batteries better than wet batteries for small spark coils?

What insulating material is recommended for saturating a primary core and winding for a 6 in. coil?

What voltage is supposed to be given by the discharge of a 2-in. induction coil? G. R. N.

Dry batteries, because of portability, commend themselves for spark coil operation in wireless telegraphy. Fuller or Edison batteries give excellent results.

An excellent and cheap way to insulate a primary is to wrap one layer of thin cloth between each layer of wire on the primary. After winding is completed, wrap 3 layers of cotton cloth over the winding and tie tightly with thread or twine. Then heat to boiling ½ lb. of paraffine wax and two ounces of resin, and immerse the core and winding for twenty minutes. Then fashion from pasteboard a tube like a mailing tube, ½ in. larger in diameter than the primary and 1 in. longer. Insert the primary in the tube, stand on end and pour the following mixture into the tube, permitting same to thoroughly harden before removing the pasteboard form. For the mixture, add 2 ounces of resin to the remaining portion of the paraffine mixture previously mentioned, and stir thoroughly. The addition of an ounce of hard South American wax is recommended by many coil makers.

A 2-in. spark is commonly called 25,000 volts. Until recently there has been a wide difference of opinion as to the voltage for any given length, owing to lack of instruments for measuring high potentials. Some of the text books of ten years ago speak of 50,000 volts to the inch, but recent investigations show these measurements to be excessive. Even today, experts disagree as to the best way of calculating the pressures at spark gaps of various lengths. The figures we give seem to be reasonably accurate.

The coal production of the United States is now about 1,000,000 tons per day, and the railroads consume about 40 per cent of it.

DEFORESTATION AND CLIMATE.

During the May session of the German Meteorological Society at Berlin, a lecture on "Deforestation and Climate" was delivered by Dr. Hennig from which United States Consul-General Guenther, Frankfort, Germany, takes the following extracts:

The interest in deforestation and forestry may be called general and public. Whether forests exercise a perceptible influence upon the climate is a very old question, and even today it is not definitely settled. In many countries a drying up of climate has occurred, which is shown perhaps most strikingly in almost the whole of Africa. That deforesting has assumed constantly growing proportions in almost every part of the world is still most apparent. The climate of Greece, where today only 16 per cent of the area is covered with forests, has deteriorated. An increase of temperature and decrease of rain are noted, compared with ancient times, especially in Attica, which was thickly covered with forests about three thousand years ago, and where hardly any rain now falls, while the heat in the open air attains a degree which would make the "Olympian games" almost an impossibility. A similar condition exists in the peninsula of Sinai, where thousands of years ago the people of Israel lived in a luxuriant and fertile country and where today only forestless deserts abound. Palmyra, also once a flourishing oasis in the Syrian desert, presents today only a desolate waste of stones and ruins. In Mexico, where the Spaniards cut down the forests in the mountains, droughths, changing to devastating floods are now noticeable, especially in the vicinity of the City of Mexico. In upper Egypt, where only one hundred years ago rain was abundant, drought now usually prevails. In Algeria, where, since the middle of the last century the forests have been cut down on a large scale, dry weather has increased, and in Venezuela the level of Lake Tacarigua, to which Alexander von Humboldt drew attnntion, has been lowered in consequence of deforestation.

If these and other facts are kept in mind the sentence "Man traverses the earth and a desert results is understood. It must not be forgotten, however, that this applies mainly to the influence of civilization upon appearances and is not always due to climatic changes produced by deforesting.

Some authorities even deny the influence of forests on the weather and climate. It cannot be denied, however, that dense forests favor moisture and prevent the drying out of the soil to a considerable degree. At any rate, deforesting, which, in modern times assumes constantly growing proportions for industrial and agricultural purposes, is of universal importance.

Germany, with a forest area of about 26 per cent, realizes annually nearly $60,000,000 worth of timber therefrom, while the wood importations are about of the same value. The consumption of wood increases from year to year, and systematic forestry has not suc-

ceeded in keeping up the forest area of Germany. If it is furthermore borne in mind that Canada, which formerly possessed more than 300,000,000 acres of forests, has today only a forest area of about 225,000,000, it becomes evident that the question of deforestation assumes great importance. If civilization continues to change the face of the earth the problem of its wood supply will present itself like that of coal, and force the finding of a suitable substitute.

SCIENCE AND INDUSTRY.

The televue, or seeing telephone, as it is called, is the invention of J. B. Fowler, of Portland, Ore. Mr. Fowler is not a scientist, but a humble workmen, who has been classed as an inventor from the days of his boyhood. His latest production in that line consists of a device used in connection with an ordinary telephone by means of which one may distinctly see the featurės of the person with whom he is carrying on a conversation. While it is admitted that the televue is still in a crude state, it is said by those who have seen it, to be not more so than was the telephone when on exhibiton at the Centennial Exposition in Philadelphia.

For a cement for sticking leather fillet on brass patterns, melt together eight parts of beeswax and two of rosin; cut into strips when cold and apply with a sticking tool of the proper radius. A steel ball of the right size stuck on a wire and heated in a bunsen burner is the best. The pattern should be slightly warmed. Superfluous cement may be removed, when all is cold, with a bit of waste dipped in turpentine.

A new industry is being formed on the boader lines of Barren, Edmondson and Hart counties, Ky., for the development of large deposits of onyx which have been found in several caves of the State. In one cave is said to exist the largest deposit of oxyx in the world, it being 200 feet in circumference and 75 feet high. The onxy is white and said to be of the finest quality. In other places the deposits are red, yellow, black and varied-colored onyx.

Electricity is not a form of energy, any more than water is a form of enery, says Sir Oliver Lodge. Water may be a vehicle of energy, when at a high level or in motion; so may electricity. Electricity cannot be manufactured, as heat can; it can only be moved from place to place, like water, and its energy must be in the form of motion or of strain. Electricity under strain constitutes a current and magnetism; electricity in vibration constitutes light.

The power obtainable by a given stream of water is, within a small factor due to friction, directly as the head, but the water is not always applied to the greatest advantage.

To make a gas engine noiseless, the following simple device can be introduced by any one at a small expense, says an English journal. A pipe split for a distance of about 80 inches is attached to the end of the exhaust with the split end upward. Beginning at the lower end of the cut, which may be best made by a saw, dividing the pipe into two halves, the slotted opening is widened out toward the top until it has a width equal to the diameter of the pipe. The puff of the exhaust spreads out like a fan, and the discharge into the open air takes place gradually. The effect produced is said to be remarkable, but it depends somewhat on the fiber of the tube.

A new method of denaturing alcohol so as to render it unfit for drinking purposes is to charge it with acetylene gas. This gas is commonly stored by dissolving it in acetone, an alcohol-like liquid which has a partial affinity for acetylene. All alcohol possesses this affinity to some extent, and ordinary grain alcohol, which is by many regarded as the future fuel for internal combustion engines, will absorb considerable quantities of the gas. Alcohol thus denatured is rendered totally unfit for drinking, while at the same time its heating power, or calorific value is increased instead of diminished, as is the case of practically all other denaturing agents. Grain alcohol now sells for 16 cents a gallon in Holland, where there is no tax upon its use for industrial purposes, and denatured with a small amount of acetylene—too little to increase its cost materially—its power value is said to be much above that of gasoline.

Tantalium as material for tools may have a wonderful future. This substance is the metal employed by Siemens and Halske for their new incandescent lamp filaments. There is a report that laboratory experiments have shown it to possess a hardness comparable with that of the diamond, and great toughness also. When, after much work, a piece of the pure metal was for the first time produced, a sheet about 1 millimetre (.039 in.) thick was hammered from it. An attempt was made to drill this, and, other means failing, diamond drill was used. Constant work for three days and nights at the rate of 5000 revolutions per minute resulted in a depth of only ¼ millimetre, and the drill was so badly worn that the experiment was discontinued. Since tantalum is thoroughly unmagnetic, it would be of use where a metal as strong as steel is needed, but where the magnetic properties of the latter are objectionable. The fusing point lies at about 2300° C. (4172° F.) its specific gravity is from 14 to 17, and in color it resembles platinum. In the form of wire it sustains a load of 90 kg. per square millimetre, or 128,000 lbs. per square inch.

It is generally figured that 1 cubic inch of water, when evaporated under atmospheric pressure, will make 1 cubic foot of steam.

A column of water 2000 feet high, no matter what the length of the pipe line, will develop a static pressure of 866 pounds per square inch.

Two elaborate telephone systems are being installed on the steamer Dakota, now under construction for the Great Northern Company. This will be the first ship to be equipped with telephones.

The main use of metallic arsenic is in the manufacture of shot. When arsenic is added to lead and dropped from a height, the shot assumes a rounded shape which otherwise, with but the pure metallic lead, would assume a tailed form.

Concrete is not a new, nor even a modern substance. Important structures built by the old Romans before the commencement of the Christian era are today sound and solid—for example, the dome of the Pantheon in Rome, 142 feet in diameter.

To fasten paper labels, etc., on iron, use a cement made as folllows: Over a water bath dissolve 4 parts by weight of gelatine in 3 parts of water; while stirring add 1 part of acetic acid, 1 part alcohol and 1 part of pulverized alum. The metal must first be rubbed with a bit of fine emery paper.

A curious property of Portland cement, said an engineer, is that when a package of cement is opened and emptied it can be dusted out so that the bulk is increased quite one-third. I will defy anyone once havtng emptied a barrel of cement to replace the whole of it in the same barrel without considerable effort.

By short circuit is meant a direct connection by accident or design of the positive and negative leads of a supply circuit or dynamo by a conductor of low resistance. This allows an excessive current to flow, which, owing to the heat produced, will fuse the leads and possibly overload the generator supplying the current and thus destroy its insulation.

The first patent issued by the United States Patent office was on July 28, 1837. During that year a total of 106 patents was issued. During 1964 the number of patents issued was 30,267, a total to the first of January, 1905, of 748,567. This number has been since increased up to June 6, 1905, to a total of 791,991. At the present rate the number of patenls issued during the calendar year, 1905, will exceed 30,000.

While working upon a foolish theory that he could convert silver into gold, Nicholas Brandt, a German chemist, in the year 1732, made the discovery of phosphorous. Evidently he did not place much importance in his discovery, as he continued in his experiments to transmute silver into gold. Being thus engaged, other chemists made a study of phosphorous, and it is to the chemist Boyle that the world gives credit for the discovery.

The 353 foot-chimney of a smelting plant in Denver, Col., has been used to support the atennæ of a De Forest wirelees telegraph station.

Time in Manila, P. I., is 13 hours later than at Washngton, and 14 hours later than at Chicago.

Donaid Murray of England has devised a printlng telegraph which will not only print telegrams at the receiving station but can be attached to a linotype machine and will set type without human aid. The inventor states, however, that the expense of the typesetting system is such that it is not likely to supersede the manual operation of linotype machines.

THERMIT.—WHAT IT IS AND DOES.

The Thermit heating and welding compound is coming to the front as a ready and practical method of effecting economy in various ways in shop practice.

One great saving brought about by its use is in the repairing of broken locomotive frames, which can be done without removing the wheels or other parts, as the welding is done with everything in place. The welded spot is as strong as the original piece itself, and in cases where the reinforcement or so-called "collar" can be left around the weld, it is really stronger than the original piece. The heat of the applied Thermit melts the broken ends, fusing them with itself; Thermit supplies the missing metal, the weld taking as large a reinforcement as the mold is made to permit.

Broken cog teeth can be recast on a wheel with Thermit steel; cracked driving wheels can be neatly mended in place, and an infinite number of useful and economical repairs made, that will keep down the scrap pile. Its use will give large resulant economy in time, patience and money.

Thermit itself is only a mixture of granulated aluminum and iron oxide, the combustion, or reaction being started by means of an ignition powder. Thermit mit itself can be thrown into the fire without igniting, as nothing less than the heat of liquid steel will cause it to burn.

As the combustion of the aluminum is supported entirely by the oxygen of the oxide, the reaction is entirely local, being confined to the crucible, there being no explosion nor any gas resulting. The reaction is complete in a few seconds and the molten metal is instantly ready to run into the mold about the broken part; the iron, sepaıated out from the oxide, makes a very good mild steel with only 0.1 carbon.

Thermit is now being manufactured in this country under the Dr. Hans Goldschmidt patents. The apparatus necessary for operations with Thermit is simple and inexpensive, and the process can be employed by any practical mechanic.